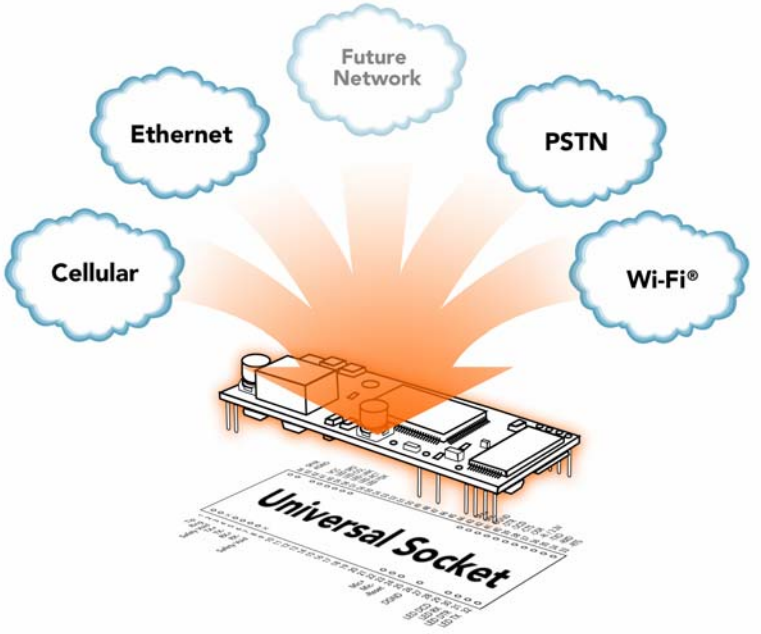
Universal Socket Connectivity
Embedded Device Networking Solutions



Hardware Guide for Developers

MultiTech® Systems

Universal Socket Connectivity
Hardware Guide for Developers, PN S000342F, Version F
For the following products:

- **SocketModem® – MT5600SMI**
- **SocketModem® – MT5656SMI**
- **SocketModem® – MT5634SMI**
- **SocketModem® – MT9234SMI**
- **SocketModem® – MT2456SMI-22**
- **SocketModem® IP – MT2456SMI-IP**
- **SocketEthernet IP® – MTXCSEM**
- **SocketEthernet IP® – MT100SEM**
- **SocketModem® ISDN – MT128SMI**
- **SocketModem® GPRS – MTSMC-G**
- **SocketModem® CDMA – MTSMC-C**
- **SocketModem® EDGE – MTSMC-E**
- **SocketWireless® Wi-Fi® – MT800SWM**
- **SocketWireless® Bluetooth® – MTS2BTSMI**

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Patents

This device covered by one or more of the following patents: 6,031,867; 6,012,113; 6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; 5,724,356; 5,673,268; 5,673,257; 5,644,594; 5,628,030; 5,619,508; 5,617,423; 5,600,649; 5,592,586; 5,577,041; 5,574,725; 5,559,793; 5,546,448; 5,546,395; 5,535,204; 5,500,859; 5,471,470; 5,463,616; 5,453,986; 5,452,289; 5,450,425; 5,355,365; 5,309,562; 5,301,274. Other Patents Pending.

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Revision Notes

Rev.	Date	Description
A	06/17/04	Initial release of Universal Socket Connectivity hardware guide.
B	10/01/04	Added SocketWireless with Bluetooth Technology chapter. Changed pinouts: TXCLK to TCLK and RXCLK to RCLK. Added the schematics for the MT128SMI. Added note to the SocketEthernet IP filtering drawing.
C	11/11/04	Revised GPRS mechanical drawing. Added location information about AT commands, fax commands, and voice commands. Updated Bluetooth chapter.
D	10/28/05	Added SocketWireless EDGE chapter. Added Recycling Statement (WEEE)
E	01/11/06	Updated Trademarks to Registered Trademarks. Added SIM Toolkit to AT Commands list. Added a contents of the Universal Developer Kit. Added R-UIM Electrical Characteristics to the CDMA chapter. Updated CDMA product list.
F	02/13/07	**General** Established a standard format for all Technical Specifications pages. Adding DAA Isolation. Created two Electrical Characteristics Tables – 3.3V and 5V – where applicable. All operating temperatures have been retested and updated where needed. **Copyright Page** Updated the phone numbers. **Chapter 1 – Universal Socket Connectivity** Updated the Recommended Parts list and added RoHS compliant. Removed part numbers from Tip and Ring drawing. Added Safety section. Removed Hazardous Locations Warning Updated the Anti-Static Warning. Add new products to Maximum Component Height table. Changed the SocketModem Developer Board drawing to provide module placement orientation by identifying pin numbers and LED numbers. Added a note on the Universal Board regarding ISDN capacitors. Added all products to the RoHS statement. Added board orientation to the ISDN Switch Blocks settings. Updated the pinout drawing and pin descriptions. Update the description of pin –RTS. Added a Wireless Approvals section. **Chapter 2 – MT5600SMI & MT5656SMI** Removed FAX Class 2 and speakerphone support from the MT5600SMI. Updated the pinout drawing. **Chapter 3 – MT5634SMI and MT9234SMI (new product MT9234SMI)** Added MT9234SMI to the MT5634SMI chapter. Added DAA Isolation for HV. Updated the pinout drawing. **Chapter 4 – MT2456SMI-22** Added the words *TOP VIEW* to the pinout drawing. Updated the pinout drawing. **Chapter 5 – MT2456SMI-IP** Added *Electrical Characteristics* tables for Rev. A Board and Rev. B Board. Changed the Web server support of HTML web pages to 30KB (64KB was wrong). Updated the pinout drawing. **Chapter 6 – MTXCSEM, MT100SEM, MTXCSEM-L-RAS (new: MT100SEM, -RAS)** Added the MT100SEM and MTXCSEM-L-RAS to this chapter. Changed the Web server support of HTML web pages to 30KB (64KB was wrong). Added HV build and DAA isolation for HV. Added information about the heartbeat LED. Updated the pinout drawing. **Chapter 7 – MT128SMI** Updated the ISDN Interface schematic. Created two Electrical Characteristics Tables – one for 3.3V and one 5V. Added *Notes* to the ISDN Interface section. Updated the pinout drawing.

Chapters 8, 9, 10 – Wireless GRPS, CDMA, and EDGE
Updated the Electrical Characteristics tables for all three.
Changed the MMCX/SMA Adapter and Antenna cable drawings for all three.
Removed the LED table in the EDGE chapter and incorporated it in Chapter 1.
Added CDMA acronyms and terminology to Chapter 9.
New mechanical drawing for EDGE.
Updated the pinout drawing.

Chapter 11 – MT800SEM (new chapter for new product)

Chapter 12 – MT2BTSMI
Moved the Bluetooth chapter to the end of this guide.
Updated approvals for Bluetooth.
Added Application Note: *Disabling Flow Control Using AT Commands*.
New mechanical drawing.
Updated the Bluetooth antenna cable drawing.
Added note about importance of not losing PIN number.
Updated the pinout drawing.

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Chapter 1

Universal Socket Connectivity

Chapter 1 - Universal Socket Connectivity

Multi-Tech Embedded Solutions

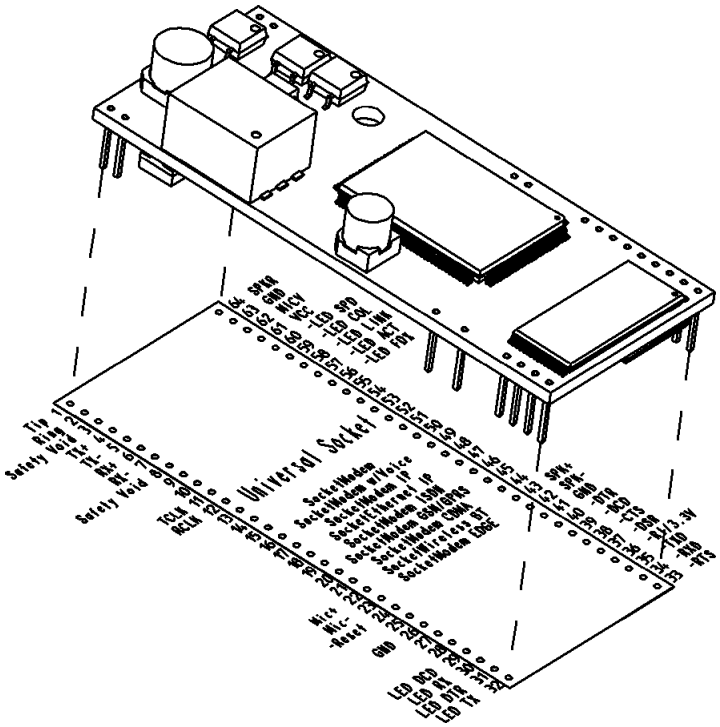
Multi-Tech's embedded device networking solutions instantly add communication ability to your existing or new product with minimal engineering effort giving you an edge on your competition while accelerating your time-to-market. Our universal socket family of embedded solutions is designed around a flexible comm-port architecture to provide analog or ISDN dial-up, cellular, Wi-Fi or Bluetooth wireless, or Ethernet socket connectivity with interchangeable modules. This means you can utilize one system design and populate it with your preferred connectivity option giving you flexibility and a seamless migration path to future technologies.

Universal Socket Connectivity Features

- Flexible comm-port architecture
- Interchangeable socket modules
- Cost-effective system design
- Easy migration to future technologies
- Complete global compliance

The Universal Socket Design

Each pin on a SocketModem corresponds to a particular function. The universal socket design provides a universal location for each function pin. This allows each SocketModem to be used in a common board.



Universal Developer Kit Contents

All products covered in this document can be evaluated using the MTSMI-UDK (Universal Developer Kit).

- One MTSMI-UDK Developer Board
- One 100-240V 9V-1A power supply w/IEC-320 connector
- One IEC-320 power cord w/US type plug
- One IEC-320 power cord w/EURO type plug
- One IEC-320 power cord w/UK type plug
- One RJ-45 cable (CARJ45NK-RJ45 7'8C non-keyed)
- One 7 foot RJ-11 cable plug - plug/4C
- One SMA jack to MMCX plug antenna cable (for CDMA and GPRS antennas)
- One RSMA jack to MMCX plug antenna cable (for Bluetooth antenna)
- One antenna 850/1900, right angle, 3-stripe (for CDMA and GPRS modules)
- One antenna 900/1800, right angle 4-stripe (for GPRS modules)
- One 2.4GHz ½ WAVE antenna with reverse polarity (for SocketWireless Bluetooth and SocketWireless Wi-Fi)
- One DB9F-DB25M 6 foot modem serial cable
- One generic CDMA Activation Notice
- One Verizon Activation Notice
- One Spring Activation Notice
- One Cingular Activation Notice
- One Universal Socket Connectivity Developer CD with BVRP Mobile PhoneTools
- One Promo Screwdriver

AT Commands Are Included on the Developer CD

AT Commands

Multi-Tech provides Reference Guides for each SocketModem's AT commands, fax commands, and voice commands. These reference guides are available on the CD included in the Developer Kit. They are also available by email at mailto:oemsales@multitech.com or by using the *Developer Guide Request Form* on Multi-Tech's Web site.

Fax Commands

Fax Commands are included in the AT Command Reference Guide when applicable to the product. They are available on the CD included in the Developer Kit.

Note: Fax Commands supported by product:

- SocketModem MT5600SMI supports Class 1 & 1.0
- SocketModem MT5656SMI supports Class 1 & 2 (not 2.0/2.1)
- SocketModem MT5634SMI supports all Class 1 and Class 2 commands (Class 1, 1.0, 2, 2.0/2.1)
- Wireless SocketModem GPRS MTSMC-G supports Class 1 core commands only (defined by ITU T.31)
- Wireless SocketModem CDMA MTSMC-C supports Class 2.0
- Wireless SocketModem EDGE MTSMC-E supports Class 1

Voice Commands

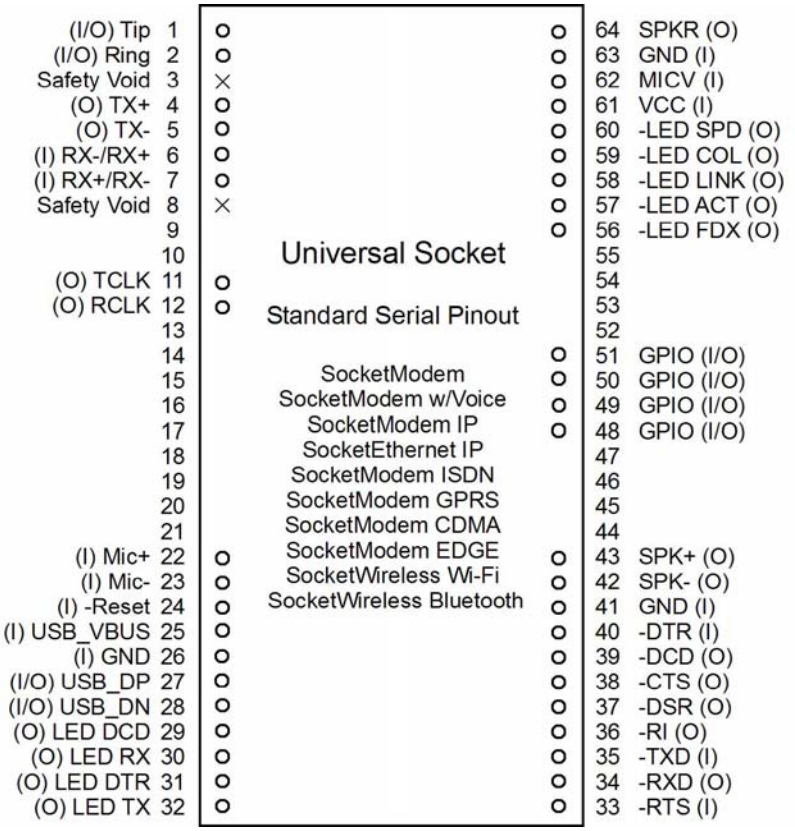
Voice Commands Reference Guides are available on the CD included in the Developer Kit.

- SocketModem MT5600SMI supports +V commands
- SocketModem MT5656SMI supports +V (including speakerphone)
- SocketModem MT5634SMI supports +V commands
- SocketModem EDGE applicable voice commands included in the EDGE AT Command Reference Guide.

Table of AT Command Documents

Product	AT Commands	Fax Commands	Voice Commands
SocketModem (MT5600SMI) (MT5656SMI)	MT5600/5656SMI AT Commands Reference Guide **(S000306x)**	Class 1 & 2 included in **S000306x**	Included in **S000306x**
SocketModem (MT5634SMI) (MT9234SMI)	MT5634SMI/MT9234SMI AT Commands Reference Guide **(S000263x)**	Class 1 & 2 included in **S000263x**	Included in **S000263x**
SocketModem (MT2456SMI-22)	MT2456SMI-22 AT Commands Reference Guide **(S000281x)**	Fax Not Supported	Voice Not Supported
SocketModem IP (MT2456SMI-IP)	MT2456SMI-IP Command Line Interface Guide and Application Examples **(S000368x)**	Fax Not Supported	Voice Not Supported
SocketEthernet IP (MTXCSEM)	SocketEthernet IP Command Line Interface Guide and Application Examples **(S000278x)**	Fax Not Supported	Voice Not Supported
SocketModem (MT100SEM)	SocketModem AT Commands Reference Guide **(S000346x)**	Fax Not Supported	Voice Not Supported
SocketModem ISDN (MT128SMI)	MT128SMI AT Commands Reference Guide and Application Examples **(S000352x)**	Fax Not Supported	Voice Not Supported
SocketModem GPRS (MTSMC-G)	GPRS AT Commands Reference Guide and Application Examples **(S000293x)**	Applicable Fax and SIM Commands included **S000293x**	Voice Not Supported
SocketModem GPRS IP (MTSMC-G)	GPRS IP AT Commands Reference Guide and Application Examples **(S000333x)**	Fax Not Supported	Voice Not Supported
SocketModem CDMA (MTSMC-C)	CDMA AT Commands Reference Guide and Application Examples **(S000294x)**	Applicable Fax Commands included in **S000294x**	Voice Not Supported
SocketModem EDGE (MTSC-E)	SocketModem EDGE AT Commands Reference Guide and Application Examples **(S000371x)**	Applicable Fax Commands included in **S000371x**	Applicable Voice Commands included in **S000371x**
SocketWireless Bluetooth (MTS2BTSMI)	SocketWireless Bluetooth AT Commands Reference Guide **(S000360x)**	Fax Not Supported	Voice Not Supported
SocketWireless Wi-Fi (MT800SWM)	SocketWireless Wi-Fi AT Commands Reference Guide **(S000345x)**	Fax Not Supported	Voice Not Supported

Universal Socket Configuration



Top View – Universal SocketModem Pinout

Note: Pin 6 is RX- for the SocketEthernet IP. For ISDN, Pin 6 is RX+.
Pin 7 is RX+ for the SocketEthernet IP. For ISDN, Pin 7 is RX-.

Universal Pin Descriptions

Pin	Signal Name	In Out	Description
1	Tip	I/O	**Tip Signal from Telco**. Tip connection to the phone line (RJ-11 Pin 4). The SocketModem is Tip/Ring polarity insensitive.
2	Ring	I/O	**Ring Signal from Telco**. Ring connection to the phone line (RJ-11 Pin 3). The SocketModem is Tip/Ring polarity insensitive.
3	Safety Void	NA	**Safety Clearance**. 2.5 mm is required between TNV circuits and SELV circuits.
4	TX+	O	**Transmit Outputs (TX+ and TX-)**. Differential transmit outputs for Ethernet and ISDN.
5	TX-	O	**Transmit Outputs (TX+ and TX-)**. Differential transmit outputs for Ethernet and ISDN.
6	RX- (Ethernet) RX+ (ISDN)	I	**Receive Inputs (RX+ and RX-)**. Differential receive input pins for Ethernet and ISDN. Dummy pin for MT800SWM.
7	RX+ (Ethernet) RX- (ISDN)	I	**Receive Inputs (RX+ and RX-)**. Differential receive input pins for Ethernet and ISDN.
8	Safety Void	NA	**Safety Clearance**. 2.5 mm is required between TNV circuits and SELV circuits.
9	Dummy		**Dummy pin for EDGE.**
11	TCLK	O	**Transmit Data Sync Clock**. TX synchronous data clock for ISDN sync data mode.
12	RCLK	O	**Receive Data Sync Clock**. RX synchronous data clock for ISDN sync data mode.
22	MIC+	I	**Microphone positive input.** See microphone sections in GPRS, CDMA, EDGE chapters.
23	MIC-	I	**Microphone negative input.** See microphpone sections in GPRS, CDMA, EDGE chapters.

<table>
<tr><th>Pin</th><th>Signal Name</th><th>In/Out</th><th>Description</th></tr>
<tr><td>24</td><td>–RESET*</td><td>I</td><td>Device Reset (with pull-up). The active low –RESET input resets the device logic and returns the configuration of the device to the original factory default values or "stored values" in the NVRAM. –RESET is tied to VCC through a time-constant circuit for “Power-on-Reset” functionality. The module is ready to accept commands after a fixed amount of time (“X” Time) after power-on or reset.
<table>
<tr><th>Model</th><th>Time Constant</th><th>"X" Time</th><th>Minimum Reset Pulse*</th></tr>
<tr><td>MT5600/5656SMI</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT5634/9234SMI</td><td>400 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT2456SMI-22</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT2456SMI-IP</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MTXCSEM</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT100SEM</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT128SMI</td><td>200 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MTSMC-G</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MT800SWM</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
<tr><td>MTS2BTSMI</td><td>250 ms</td><td>6 seconds</td><td>100us</td></tr>
</table>
*The SocketModem device may respond to a shorter reset pulse.
Reset Line Interface for the MT5656SMI, MT2456SMI, MT2456SMI-IP. The modem’s reset line employs a .01uF cap and a 10K pull up resistor. Care must be taken to ensure the system the modem is place into is not affected by the added capacitance of the reset line. It is not advisable to use an open collector driver in the embedded system's reset circuitry to drive a reset signal to the embedded modem and other I.C.s in the customer’s design. Rather, if an open collector driver is to be used, run that output to the modem only and use a separate driver for other embedded components. The modem’s reset signal may also be driven by a circuit that both sinks and sources current if desired.
It is also important to note that these modems do not require an external reset. They have their own internal reset circuitry and voltage monitor and will function correctly even if the reset input is open.
Reset GPRS and CDMA (MTSMC-G and MTSMC-C). This signal is used to force a reset procedure by providing low level during reset of at least 500us. The signal is considered an emergency reset only. A reset procedure is already driven by internal hardware during the power-up sequence. If no external reset is necessary, this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain.
Reset EDGE with pull-up (MTSMC-E). The active low –RESET input resets the device logic and returns the configuration of the device to the original factory default values of "stored values" in the NVRAM. –RESET is tied to VCC through a time-constant circuit for “Power-on-Reset” functionality. The module is ready to accept commands after a fixed amount of time after power-on or reset.</td></tr>
<tr><td>25</td><td>USB_VBUS</td><td>I</td><td>USB Voltage Sense. Senses the voltage level of the USB to determine if the bus is available.</td></tr>
<tr><td>26</td><td>GND</td><td>GND</td><td>Logic Ground.</td></tr>
<tr><td>27</td><td>USB_DP</td><td>I/O</td><td>USB Data Positive. Positive pin of the USB data pair.</td></tr>
<tr><td>27</td><td>USB_DN</td><td>I/O</td><td>USB Data Negative. Negative pin of the USB data pair.</td></tr>
<tr><td>29</td><td>LED DCD</td><td>O</td><td>DCD (Active High). Output from 74LCX14 with a 1000 Ohms resistor in series.
SocketWireless Bluetooth (MTS2BTSMI): When lit, indicates a connection. No series resistor.</td></tr>
<tr><td>30</td><td>LED RX</td><td>O</td><td>RX (Active High). Output from 74LCX14 with a 1000 Ohms resistor in series.
SocketWireless Bluetooth (MTS2BTSMI): No series resistor.</td></tr>
<tr><td>31</td><td>LED DTR</td><td>O</td><td>DTR (Active High). Output from 74LCX14 with a 1000 Ohms resistor in series.
SocketWireless Bluetooth (MTS2BTSMI): No series resistor.</td></tr>
<tr><td>32</td><td>LED TX</td><td>O</td><td>TX (Active High). Output from 74LCX14 with a 1000 Ohms resistor in series.
SocketWireless Bluetooth (MTS2BTSMI): No series resistor.</td></tr>
<tr><td>33</td><td>–RTS</td><td>I</td><td>Request to Send (Active Low). –RTS is controlled by the DTE to indicated whether or not the DTE is ready to receive data. –RTS ON (low) indicates that the DTE is ready to receive data from the modem on RXD. –RTS OFF indicates to the module that it should not transfer data on the RXD.
In the command state, the modem ignores –RTS.
Note: When the –RTS pin is not in use, it should be tied low.</td></tr>
</table>

*** RESET – A Design Consideration:** Allowing the host processor to control the RESET line of the module provides the benefit of allowing the host to reset the device in the event of a failure to respond normally. Resetting the module will return it to a known functional state.

Pin	Signal Name	In/Out	Description
34	–RXD	O	**Received Data**. The module uses the RXD line to send data to the DTE and to send module responses to the DTE. In command mode, –RXD data presents the module responses to the DTE. Module responses take priority over incoming data when the two signals are in competition for –RXD. When no data is transmitted, the signal is held in mark condition.
35	–TXD	I	**Transmitted Data**. The DTE uses the –TXD line to send data to the module for transmission or to transmit commands to the module. The DTE holds this circuit in mark state when no data is being transmitted or during intervals between characters.
36	–RI	O	**RING (Active Low)**. Incoming ring signal from phone. **Ring Indicate.** –RI output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will not go off-hook when –RI is active; the modem waits for –RI to go inactive before going off-hook. **SocketWireless Bluetooth (MTS2BTSMI).** Strobes 1/sec for slave indication.
37	–DSR	O	**Data Set Ready (Active Low)**. –DSR indicates module status to the DTE. –DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (–RI). It reflects the status of the local data set and does not indicate an actual link with any remote data equipment.
38	–CTS	O	**Clear to Send (Active Low)**. –CTS is controlled by the module to indicate whether or not the module is ready to transmit data. –CTS ON indicates to the DTE that signals on TXD will be transmitted. –CTS OFF indicates to the DTE that it should not transfer data on TXD.
39	–DCD	O	**Data Carrier Detect (Active Low)**. –DCD output is ON (low) when a data connection is established and the module is ready to send/receive data.
40	–DTR	I	**Data Terminal Ready (Active Low)**. The –DTR input is turned ON (low) when the DTE is ready to communicate. –DTR ON prepares the modem to be connected, and, once connected, maintains the connection. –DTR OFF places the modem in the disconnect state under control of the &Dn and &Qn commands. **Note:** When the –DTR pin is not in use, it should be tied low.
41	GND	GND	**Logic Ground**.
42	SPK-	O	**Wireless GPRS, CDMA, and EDGE.** Negative analog speaker output.
43	SPK+	O	**Wireless GPRS, CDMA, and EDGE.** Positive analog speaker output.
48	GPIO	I/O	**General Purpose Input/Output.** User-configurable input or output pin.
49	GPIO	I/O	**General Purpose Input/Output.** User-configurable input or output pin.
50	GPIO	I/O	**General Purpose Input/Output.** User-configurable input or output pin.
51	GPIO	I/O	**General Purpose Input/Output.** User-configurable input or output pin.
56	–LED FDX	O	**LED Full Duplex (Active Low)**. LED Output. During normal operation, this pin lights the FDX LED to indicate a full duplex mode.
57	–LED ACT	O	**LED Active (Active Low)**. LED Output. During normal operation, this pin lights the Activity LED when transmitting or receiving. It flashes at a rate of 50ms high and 50ms low when active.
58	–LEDLINK	O	**LED LINK (Active Low)**. LED Output. During normal operation, this pin lights the LINK LED to indicate a good link is detected.

Pin 58 LED Mode	Operating Status
Off	Subscriber Carrier Mode is Off or running in SLEEP mode or Alarm mode.
600 ms ON / 600ms OFF	No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
75 ms ON / 75 ms OFF / 75 ms ON 3 s OFF Flashing	One or more GPRS contexts activated. Indicates GPRS data transfer: When a GPRS transfer is in progress, the LED goes on within 1 second after data packets were exchanged. Flash duration is approximately 0.5 s.
ON	Depending on type of call: Voice Call: Connected to remote party. Data Call: Connected to remote party or exchange of parameters while setting up or disconnecting a call.

59	–LEDCOL	O	**LED Collision (Active Low)**. LED Output. During normal operation, this pin lights the COL LED to indicate a collision. It flashes at 50ms high and 50ms low when active.
60	–LEDSPD	O	**LED Speed (Active Low)**. LED Output. During normal operation, this pin lights the SPEED LED to indicate 100Mbps is selected.
61	VCC	PWR	**DC Input Power**. 3.3V or 5VDC power, depending upon the build.

Pin	Signal Name	In/Out	Description
62	MICV	I/O	**Single-Ended Microphone**. Single-ended microphone input for dial-up SocketModem speakerphone and TAM functions.
63	AGND	GND	**Analog Ground**. Analog ground is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker**. Dual purpose output for call progress signals or speakerphone functions. **Call Progress** signaling on MT5600SMI, MT5656SMI, and MT2456SMI-22 is a square wave output that can be optionally connected to a low-cost single-ended speaker; e.g., a sounducer or an analog speaker circuit. Call progress on the MT5634SMI is an analog output. **Speakerphone Output** on the MT5656SMI is under the control of +FCLASS. This is a single-ended analog output. SPKR is tied directly to the CODEC. One side of a differential AC output coupled through a 6.8K ohm resistor and capacitor.

Design Considerations

Noise Suppression Design Considerations

Engineering noise-suppression practices must be adhered to when designing a printed circuit board (PCB) containing the SocketModem module. Suppression of noise is essential to the proper operation and performance of the modem itself and for surrounding equipment.

Two aspects of noise in an OEM board design containing the SocketModem must be considered: on-board/off-board generated noise that can affect digital signal processing. Both on-board and off-board generated noise that is coupled on-board can affect interface signal levels and quality. Of particular concern is noise in frequency ranges affecting modem performance.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is a separate, but equally important, concern. This type of noise can affect the operation of surrounding equipment. Most local government agencies have stringent certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, etc.) component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

Other aspects of proper noise-suppression engineering practices are beyond the scope of this designer guide. The designer should consult noise suppression techniques described in technical publications and journals, electronics and electrical engineering text books, and component supplier application notes.

PC Board Layout Guidelines

In a 4-layer design, provide adequate ground plane covering the entire board. In 4-layer designs, power and ground are typically on the inner layers. All power and ground traces should be 0.05 inches wide.

The recommended hole size for the SocketModem pins is 0.036 in. +/-0.003 in. in diameter. Spacers can be used to hold the SocketModem vertically in place during the wave solder process. A spacer should be placed on pin 32 and pin 64 of the SocketModem. A suggested part number for the spacer is BIVAR 938-0.130 for P1 (0.310in) option SocketModems. The spacers can be left on permanently and will not effect operation.

All creepages and clearances for the SocketModem have been designed to meet requirements of safety standards EN60950 or EN60601. The requirements are based on a working voltage of 125V or 250V. When the recommended DAA* circuit interface is implemented in a third party design, all creepage and clearance requirements must be strictly followed in order to meet safety standards. The third party safety design must be evaluated by the appropriate national agency per the required specification.

User accessible areas: Based on where the third party design is to be marketed, sold, or used, it may be necessary to provide an insulating cover over all TNV exposed areas. Consult with the recognized safety agency to determine the requirements.

Note: Even if the recommended design considerations are followed, there are no guarantees that a particular system will comply with all the necessary regulatory requirements. It is imperative that specific designs be completely evaluated by a qualified/recognized agency.

**DAA stands for Data Access Arrangement. DAA is the telephone line interface of the module.*

Electromagnetic Interference (EMI) Considerations

The following guidelines are offered to specifically help minimize EMI generation. Some of these guidelines are the same as, or similar to, the general guidelines but are mentioned again to reinforce their importance. In order to minimize the contribution of the SocketModem-based design to EMI, the designer must understand the major sources of EMI and how to reduce them to acceptable levels.

1. Keep traces carrying high frequency signals as short as possible.
2. Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.
3. Decouple power from ground with decoupling capacitors as close to the SocketModem module power pins as possible.
4. Eliminate ground loops, which are unexpected current return paths to the power source and ground.
5. Decouple the telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines; however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.
6. Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.
7. Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.
8. Locate cables and connectors so as to avoid coupling from high frequency circuits.
9. Lay out the highest frequency signal traces next to the ground grid.
10. If a multilayer board design is used, make no cuts in the ground or power planes and be sure the ground plane covers all traces.
11. Minimize the number of through-hole connections on traces carrying high frequency signals.
12. Avoid right angle turns on high frequency traces. Forty-five degree corners are good; however, radius turns are better.
13. On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.
14. Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

Electrostatic Discharge Control

All electronic devices should be handled with certain precautions to avoid damage due to the accumulation of static charge.

See the ANSI/ESD Association Standard (ANSI/ESD S20.20-1999) – a document “for the Development of an Electrostatic Discharge Control for Protection of Electrical and Electronic Parts, Assemblies and Equipment.” This document covers ESD Control Program Administrative Requirements, ESD Training, ESD Control Program Plan Technical Requirements (grounding/bonding systems, personnel grooming, protected areas, packaging, marking, equipment, and handling), and Sensitivity Testing.

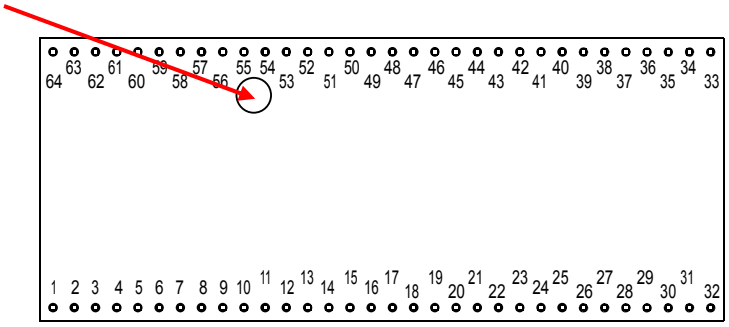
Multi-Tech Systems, Inc. strives to follow all of these recommendations. Input protection circuitry has been incorporated into the Multi-Tech devices to minimize the effect of this static buildup, proper precautions should be taken to avoid exposure to electrostatic discharge during handling.

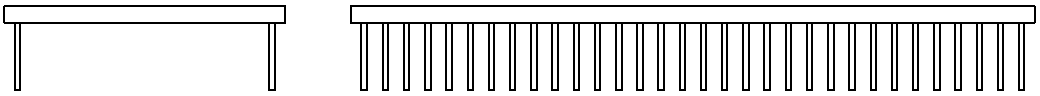
Multi-Tech uses and recommends that others use anti-static boxes that create a faraday cage (packaging designed to exclude electromagnetic fields). Multi-Tech recommends that you use our packaging when returning a product and when you ship your products to your customers.

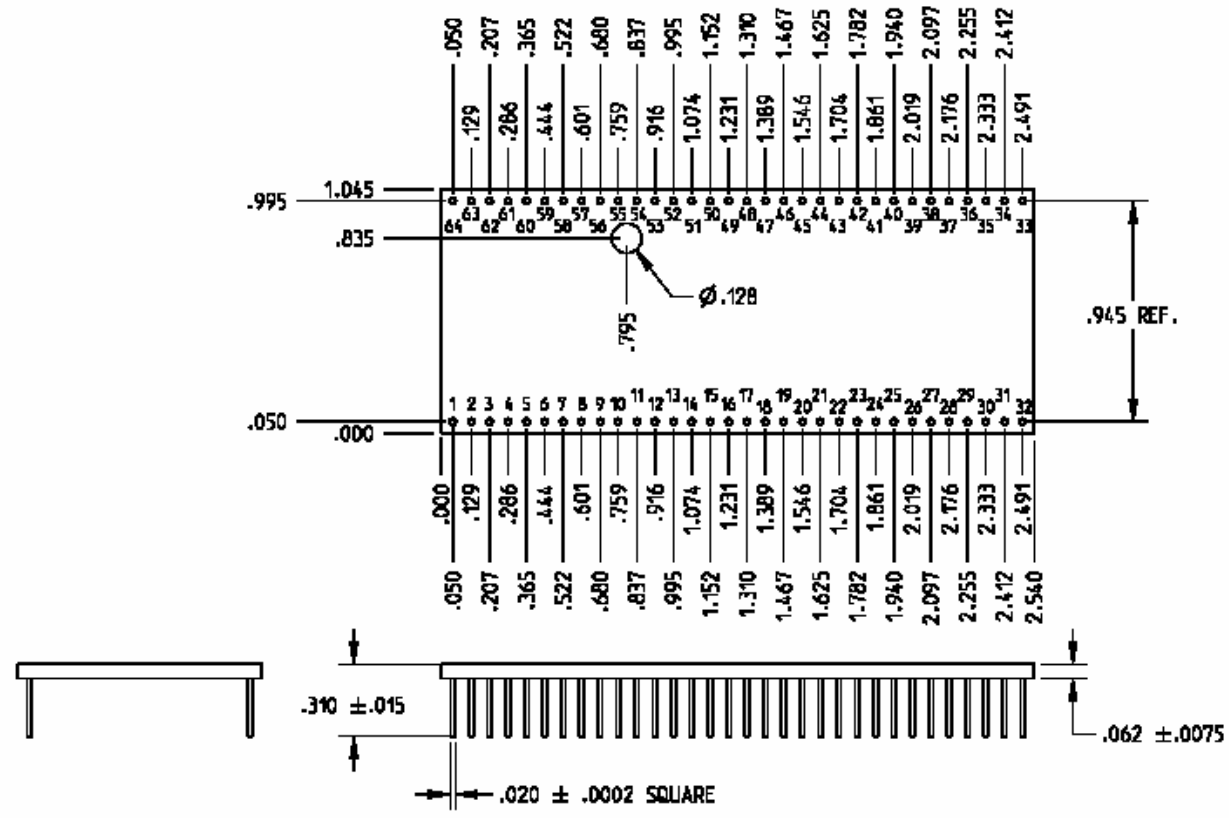
Mechanicals and Schematics

Mechanical Dimensions in Inches

Note: This tooling hole is not on all models.

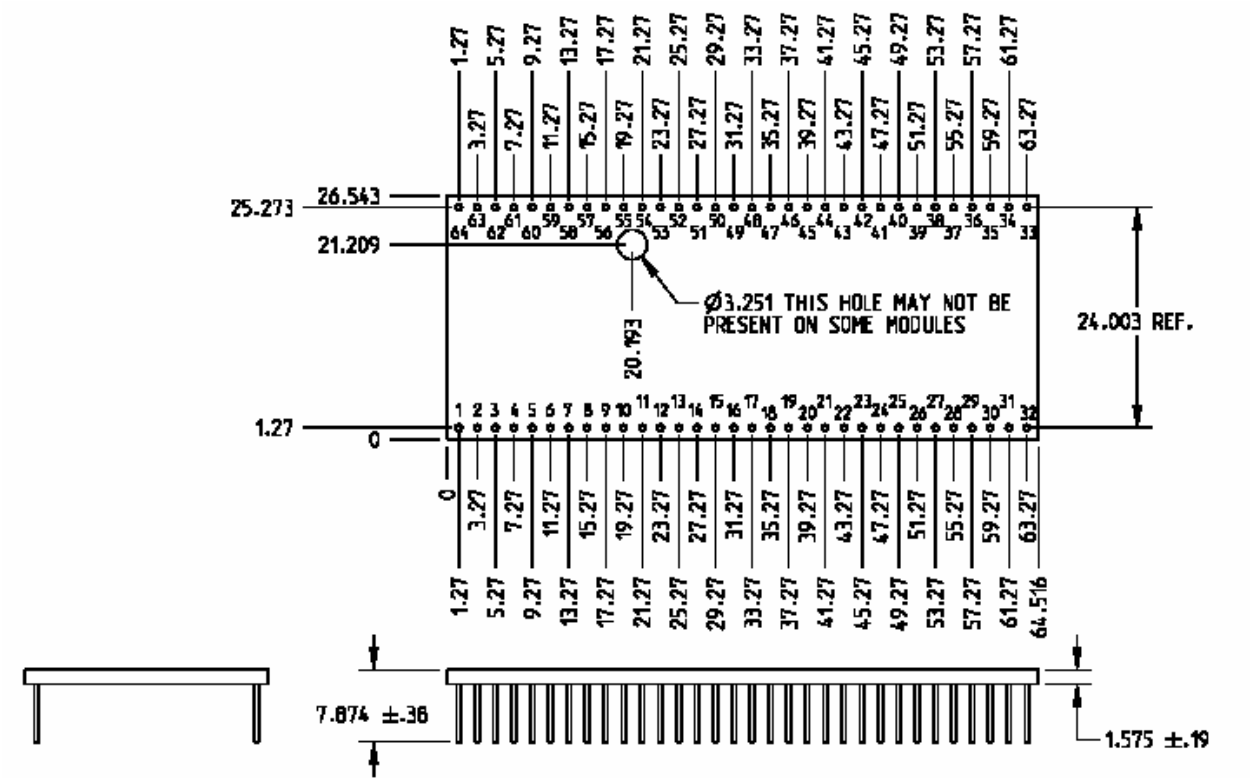






Dimensions Are Shown in Inches

Mechanical Dimensions in Millimeters



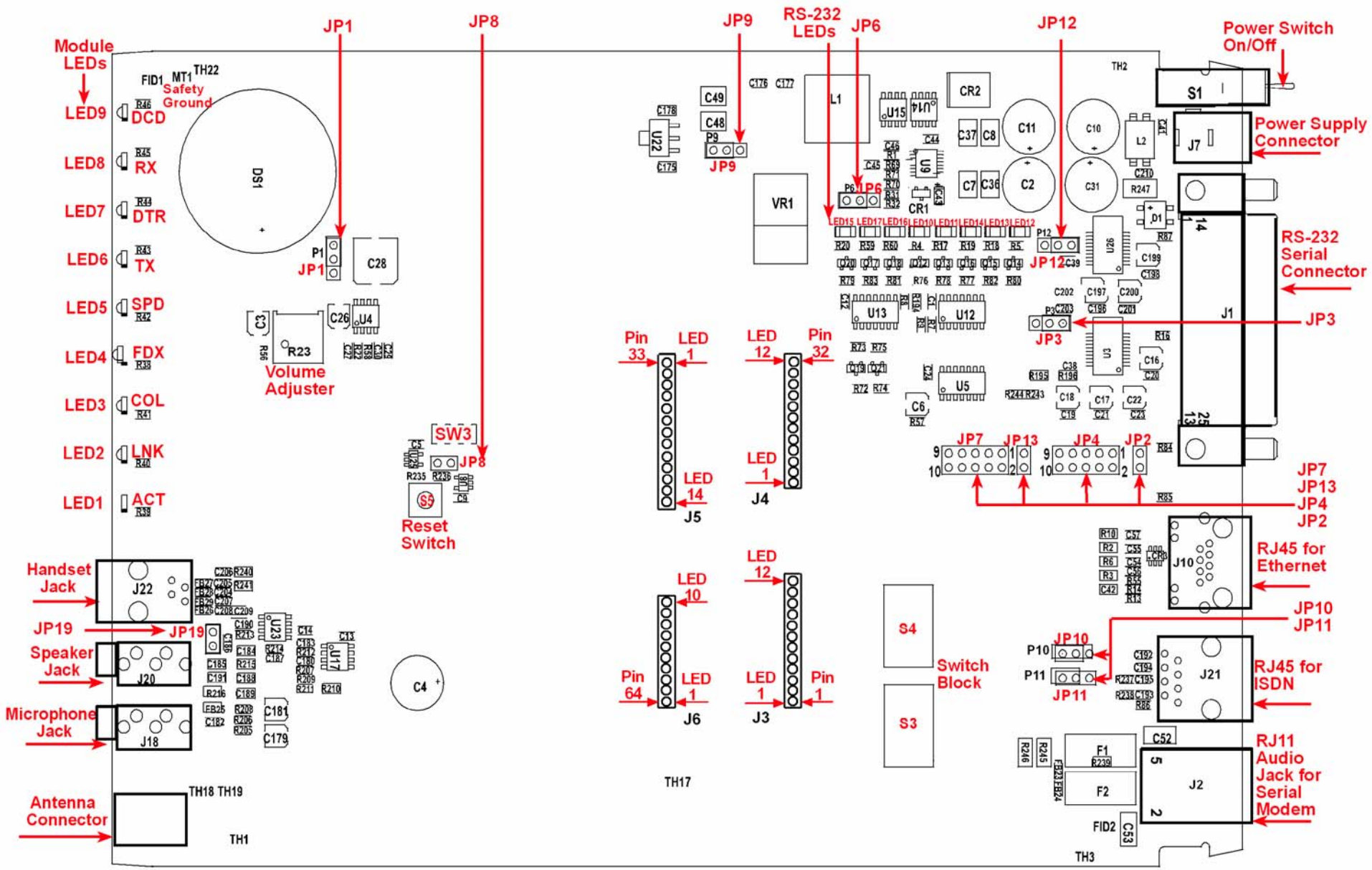
Dimensions Are Shown in Millimeters

Maximum Component Height

Product	Measurement from top of board to highest topside component	Measurement from bottom of board to lowest bottom-side component
SocketModem – MT5600SMI	.110 inches (2.794 mm)	.110 inches (2.794 mm)
SocketModem – MT5656SMI	.212 inches (5.384 mm)	.110 inches (2.794 mm)
SocketModem – MT5634SMI	.290 inches (7.366 mm)	.114 inches (2.895 mm)
SocketModem – MT9234SMI	.290 inches (7.366 mm)	.114 inches (2.895 mm)
SocketModem – MT2456SMI	.212 inches (5.384 mm)	.110 inches (2.794 mm)
SocketModem IP – MT2456SMI-IP	.228 inches (5.791 mm)	.114 inches (2.895 mm)
SocketEthernet IP – MTXCSEM	.315 inches (8.001 mm)	.075 inches (1.905 mm)
SocketEthernet IP – MT100SEM	.341 inches (8.661 mm)	.110 inches (2.794 mm)
SocketModem ISDN – MT128SMI	.299 Inches (7.594)	.069 inches (1.752)
SocketModem GPRS – MTSMC-G	.153 inches (3.886 mm)	.118 inches (2.997 mm)
SocketModem CDMA – MTSMC-C	.238 inches (6.045 mm)	.118 inches (2.997 mm)
SocketModem EDGE – MTSMC-E	.253 inches (6.426 mm)	.118 inches (2.997 mm)
SocketWireless Wi-Fi – MT800SWM	.202 inches (5.130)	NA
SocketWireless Bluetooth – MTS2BTSMI	.270 inches (6.858 mm)	NA

SocketModem Developer Board

This developer board drawing shows the major board components for all SocketModems.



See the next page for description of Board Components

Board Components

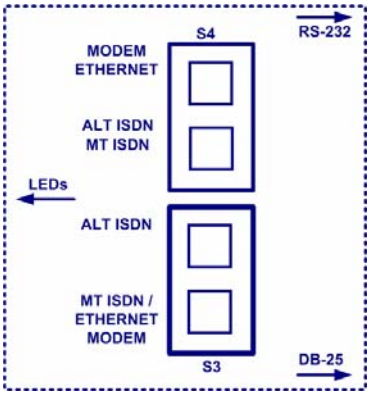
Jumper	Description
JP1	Mutes the speaker. Default positions are 1 and 2 (speaker is not muted).
JP2 & 4	Testing interface (debugging) for the RS-232 signals.
JP3	Changes the speed of the driver. For Multi-Tech use only. Default positions are 1 and 2 (transceiver operates normally).
JP6 & JP9	JP6 & JP9 are the 5V / 3.3V regulators. The operating voltage factory default setting is 3.3V. JP1 jumper must be set to 3.3V. **Warning** – Be sure to that 5V / 3.3V jumper is set to match the requirements of your SocketModem. If this jumper is set incorrectly, damage to the SocketModem and/or the Test/Demo card could result. **Caution** – Use only the provided Multi-Tech Systems, Inc. transformer with the Test/Demo board. Use of any other power source will void the warranty and will likely damage the Test/Demo board and the SocketModem. The transformer connector is keyed to prevent improper connection to the Test/Demo board.
JP7 & JP13	Testing interface (debugging) for the serial TTL signals.
JP8	Enables/disables the Watchdog interface.
JP10 & JP11	100 OHM terminator for ISDN. Default positions are 1 and 2 (off).
JP12	Ties the TX and RX clock lines together. Default positions are 1 and 2 (transmit and receiver clock act independently.
JP19	Allows a stereo jack feed. Default is ON. If ON, then left and right stereo channels are combined and form a mono channel.
Switch 3	Sets the alternate ISDN clock. Default position is OFF (the alternate ISDN clock is off).
Switch Block	Set the switch to the product being used.

Pins and Corresponding Signals

J4 and J7			
10	PWR	9	RI
8	CTS	7	RTS
6	DSR	5	GND
4	DTR	3	TXD
2	RXD	1	DCD

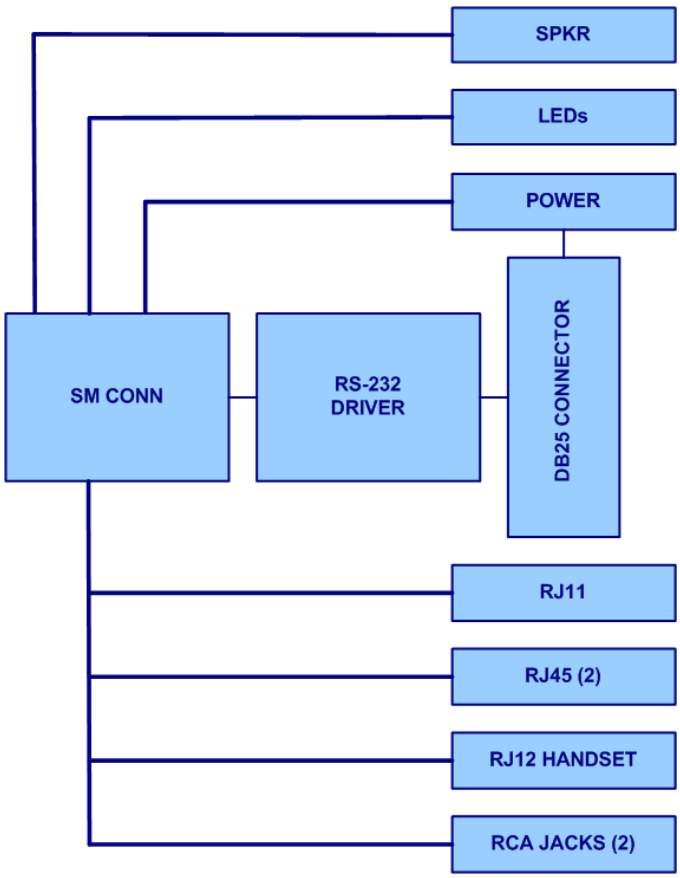
J2 and J13			
2	RXC	1	TXC

Table of Switch Blocks

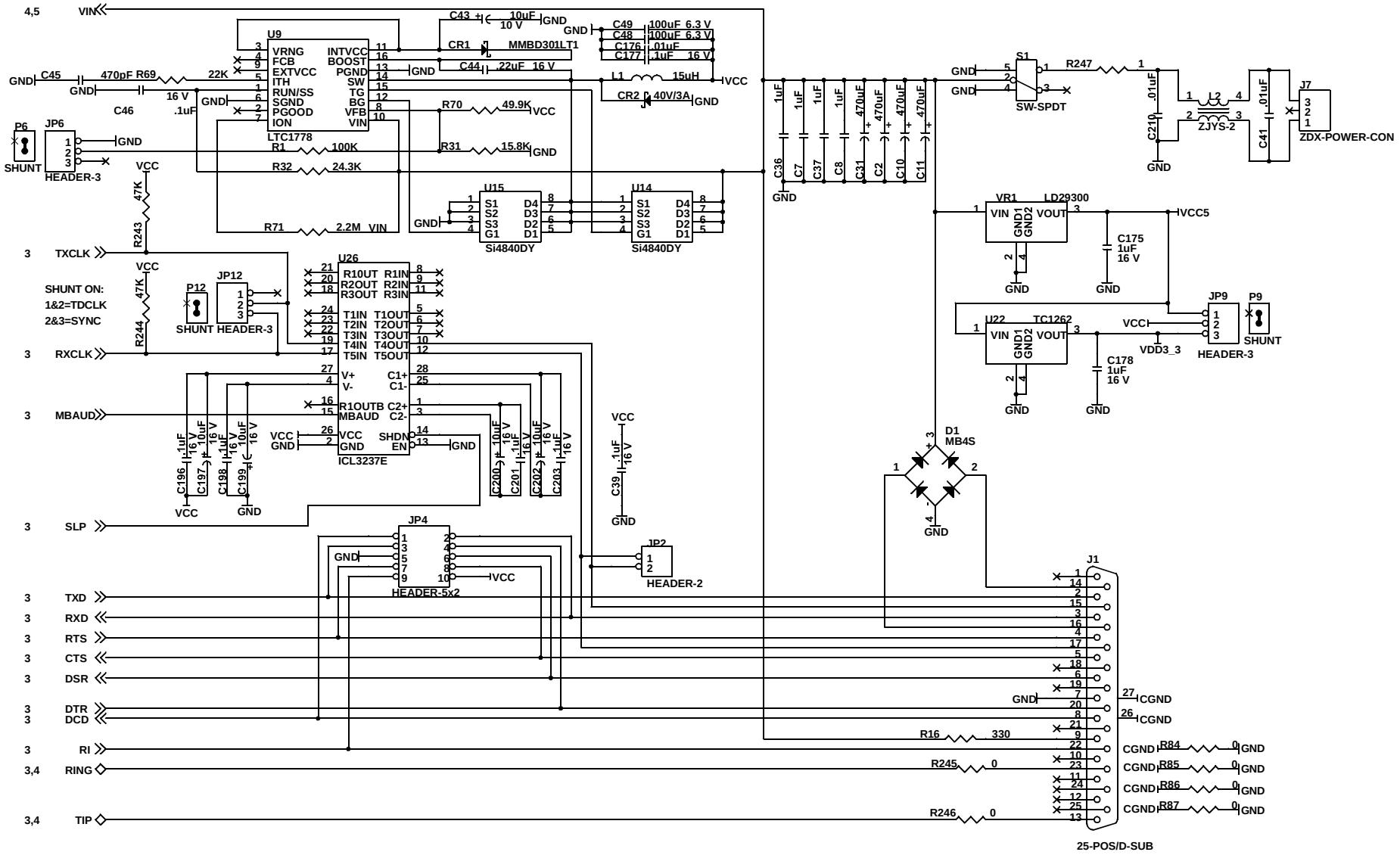
Switch Blocks and Board Orientation	Module Style	Board Labels & Block Settings – S4	Board Labels & Block Settings – S3
	Non-ISDN SocketModems and SocketEthernet IP	"MODEM ETHERNET"	"MT ISDN / ETHERNET MODEM"
	Standard ISDN	"ALT ISDN MT ISDN"	"MT ISDN / ETHERNET MODEM"
	Alternate ISDN	"ALT ISDN MT ISDN"	"ALT ISDN"

Note: ***ALT*** stands for alternate ISDN

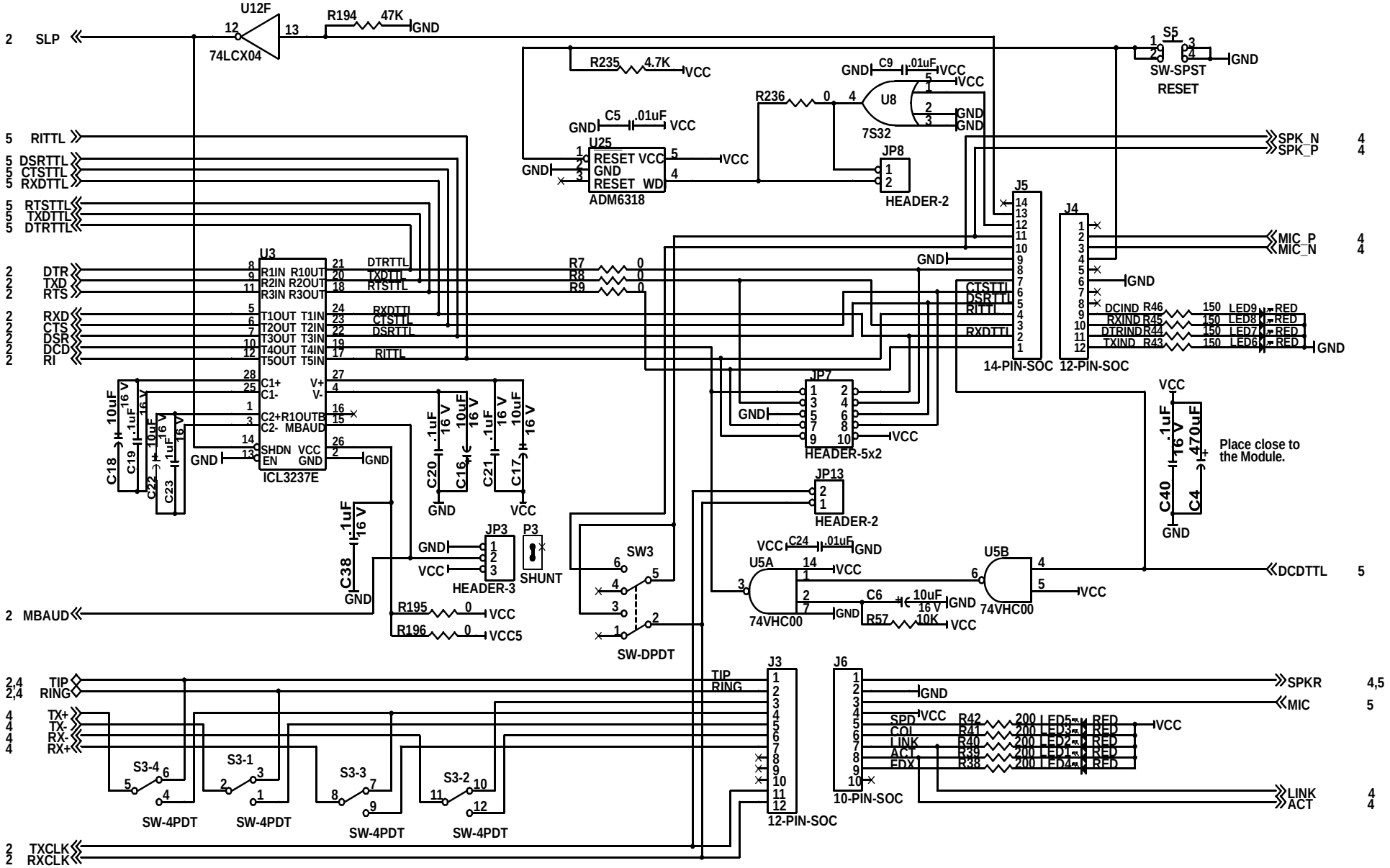
SocketModem Developer Board Block Diagram



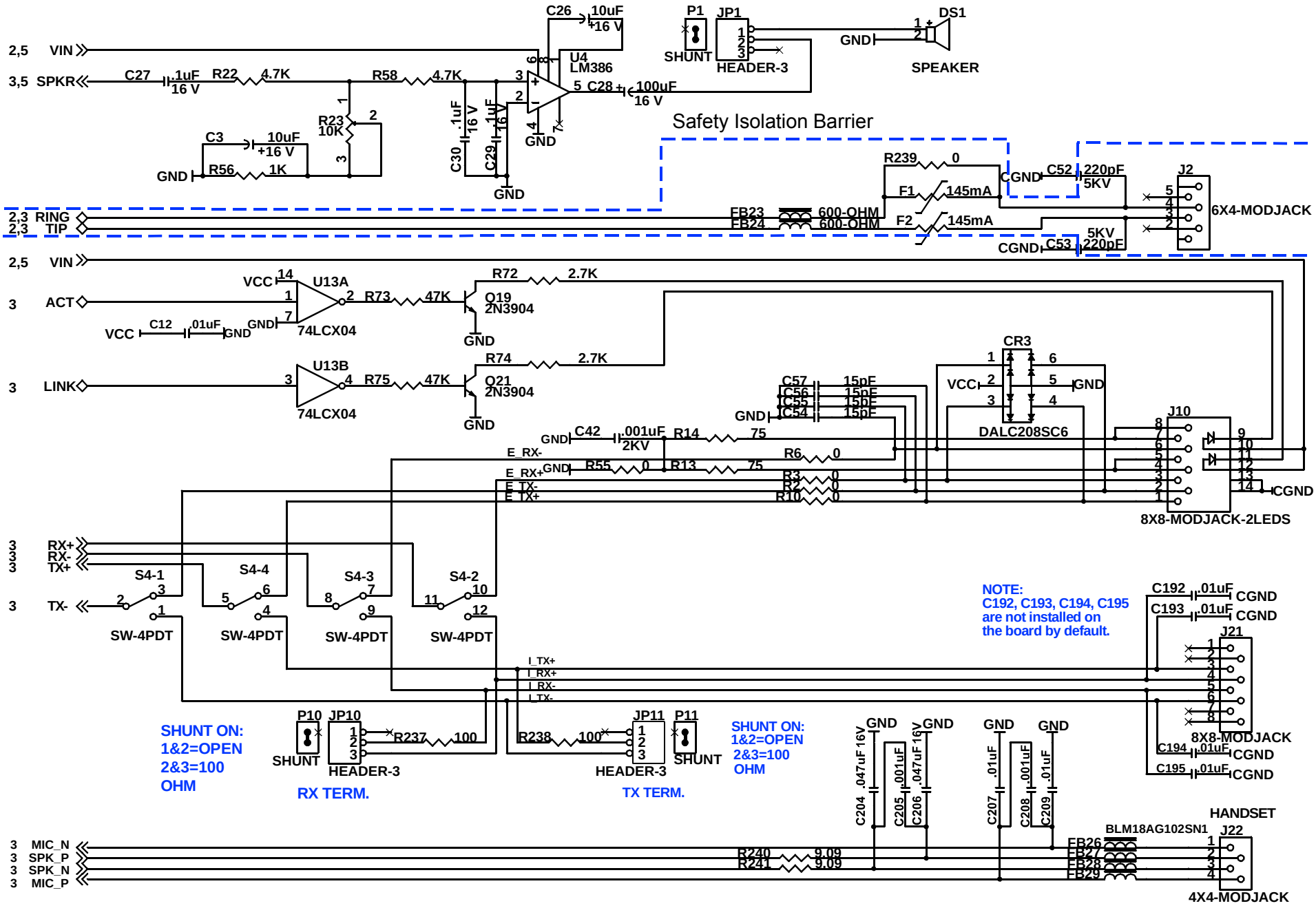
Developer Board Schematics



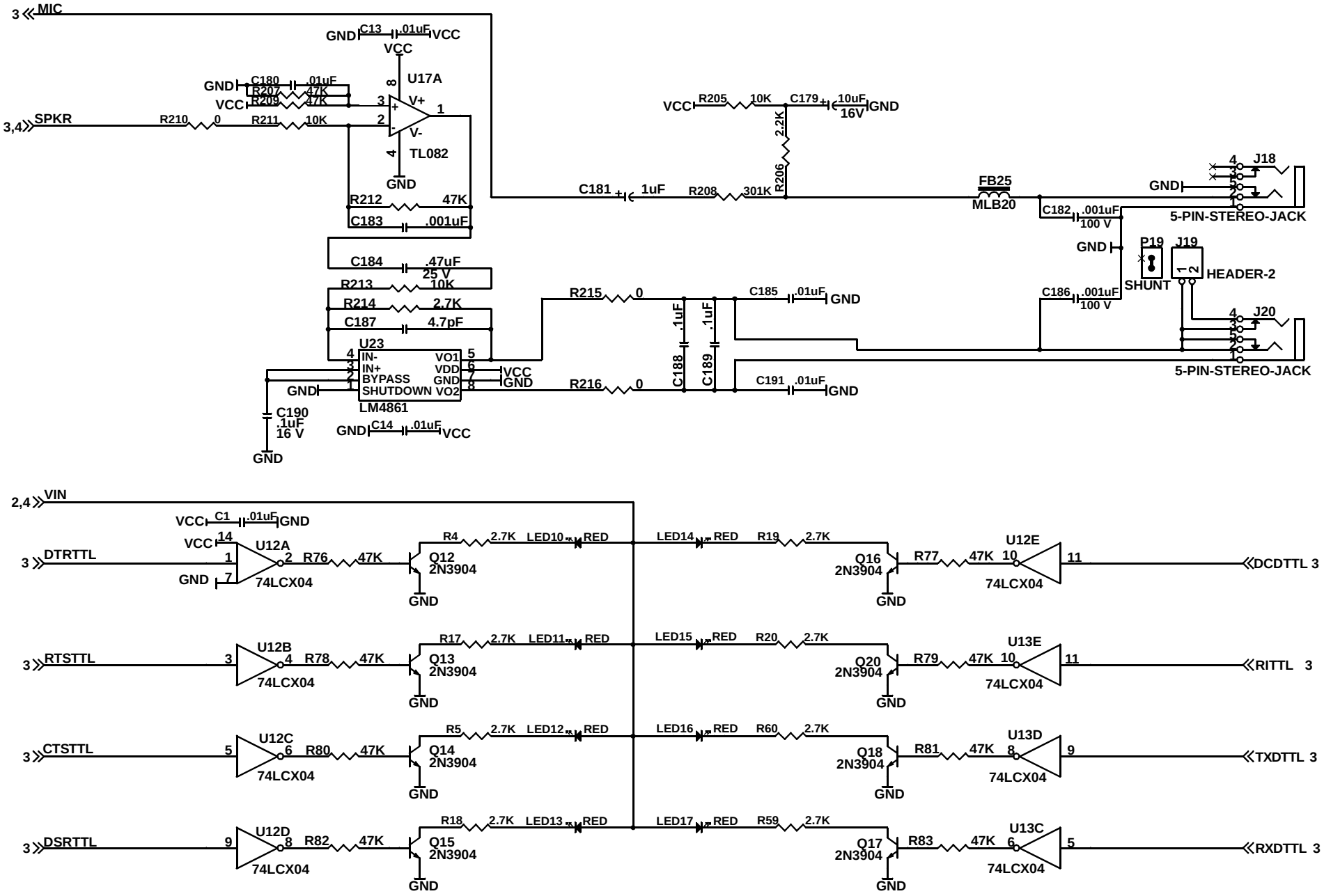
Developer Board Schematics



Developer Board Schematics



Developer Board Schematics



Recommended Parts for Non-Wireless Modules

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems.

The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Note: These parts are RoHS compliant.

Recommended Ferrite (SMT)
Manufacturer – Associated Component Technology (ACT) Part # CBZ1206-202-30-LF
Manufacturer – Murata Erie Part # BLM31AJ601SN1L

Recommended Ferrite (Thru-Hole)
Manufacturer – Associated Component Technology (ACT) Part # WB2-2.OT

Recommended Capacitor (SMT)
Manufacturer – NOVACAP Part # ES2211N221K502NXT
Manufacturer – Murata Erie Part # GA355DR7GC221KY02L

Recommended Capacitor (Thru-Hole)
Manufacturer – Ever Grace Electronic Industrials Part # YP221K2EA7PS-8.0
Manufacturer – Murata Erie Part # DE2B3KH221KA3B
Note: Capacitors used on T&R must have the Y2 safety rating.

Recommended Connector
Manufacturer – Stewart Part # SS-64600-006F

Recommended Sidactor
Manufacturer – Teccor Electronics (LittelFuse) Part # P3100SAL
Manufacturer – ST Microelectronics Part# SMTPA270
Manufacturer – ST Microelectronics Part # SMP100LC-270

Recommended Poly Switch Thermal Fuse (SMT)
Manufacturer – RayChem (Tyco Electronics) Part # TS600-170F

Recommended Poly Switch Thermal Fuse (Thru-Hole)
Manufacturer – RayChem (Tyco Electronics) Part# TRF600-150

Note: The Fuse & Sidactor are required in order to comply with UL60950 for protection against over-voltages from power line cross. Fuse can be reset type.

Common Mode Choke
Manufacturer – TDK Part # ZJYS51R5-2PT-01

Recommended Transceiver
Manufacturer – Analog Devices Part # ADM207EARZ

Dip Connector
Manufacturer – Specialty Electronics (www.connectorsolutions.com)
4-Pin 2.0mm SIP Socket (2 Each)
10-Pin 2.0mm SIP Socket (2 Each)

Telecom
The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is required in order to comply with FCC Part 68 compliance regulations.

Note: See *Application Notes* at the end of each SocketModem chapter.

Safety Notices and Warnings

Note to OEMs: The following safety statements may be used in the documentation of your final product applications.

Telecom Safety Warning

1. Never install telephone wiring during a lightning storm.
2. Never install a telephone jack in wet locations unless the jack is specifically designed for wet locations.
3. This product is to be used with UL and cUL listed computers.
4. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
5. Use caution when installing or modifying telephone lines.
6. Avoid using a telephone during an electrical storm. There may be a remote risk of electrical shock from lightning.
7. Do not use a telephone in the vicinity of a gas leak.
8. To reduce the risk of fire, use only 26 AWG or larger telecommunication line cord.
9. This product must be disconnected from its power source and telephone network interface when servicing.

Wireless Safety

General Safety

The modem is designed for and intended to be used in fixed and mobile applications. “Fixed” means that the device is physically secured at one location and is not able to be easily moved to another location. “Mobile” means that the device is designed to be used in other than fixed locations.

Caution: Maintain a separation distance of at least 20 cm (8 inches) is normally maintained between the transmitter’s antenna and the body of the user or nearby persons. The Modem is not designed for or intended to be used in portable applications within 20 cm. (8 inches) of the body of the user.

RF Interference Issues

It is important to follow any special regulations regarding the use of radio equipment due in particular to the possibility of radio frequency, RF, interference. Please follow the safety advice given below carefully.

- Switch OFF your Wireless MultiModem when in an aircraft. The use of cellular telephones in an aircraft may endanger the operation of the aircraft, disrupt the cellular network and is illegal. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both.
- Switch OFF your Wireless MultiModem when around gasoline or diesel-fuel pumps and before filling your vehicle with fuel.
- Switch OFF your Wireless MultiModem in hospitals and any other place where medical equipment may be in use.
- Respect restrictions on the use of radio equipment in fuel depots, chemical plants or where blasting operations are in progress.
- There may be a hazard associated with the operation of your Wireless MultiModem close to inadequately protected personal medical devices such as hearing aids and pacemakers. Consult the manufacturers of the medical device to determine if it is adequately protected.
- Operation of your Wireless MultiModem close to other electronic equipment may also cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers’ recommendations.

Vehicle Safety

- Do not use your MultiModem while driving.
- Respect national regulations on the use of cellular telephones in vehicles. Road safety always comes first.
- If incorrectly installed in a vehicle, the operation of Wireless MultiModem telephone could interfere with the correct functioning of vehicle electronics. To avoid such problems, be sure that qualified personnel have performed the installation. Verification of the protection of vehicle electronics should be part of the installation.
- The use of an alert device to operate a vehicle's lights or horn on public roads is not permitted.

Maintenance of Your Modem

Your Wireless MultiModem is the product of advanced engineering, design, and craftsmanship and should be treated with care. The suggestions below will help you to enjoy this product for many years.

- Do not expose the Wireless MultiModem to any extreme environment where the temperature is above 50ºC or humidity is above 90% noncondensing.
- Do not attempt to disassemble the Wireless MultiModem. There are no user serviceable parts inside.
- Do not expose the Wireless MultiModem to water, rain, or spilled beverages. It is not waterproof.
- Do not place the Wireless MultiModem alongside computer discs, credit or travel cards, or other magnetic media. The phone may affect the information contained on discs or cards.
- The use of accessories not authorized by Multi-Tech or not compliant with Multi-Tech's accessory specifications may invalidate the warranty of the Wireless MultiModem.
- In the unlikely event of a fault in the Wireless MultiModem, contact Multi-Tech Tech Support.

Your Responsibility

This Wireless MultiModem is your responsibility. Please treat it with care respecting all local regulations. It is not a toy. Therefore, keep it in a safe place at all times and out of the reach of children.

Try to remember your Unlock and PIN codes. Become familiar with and use the security features to block unauthorized use and theft.

Upgrading Firmware

Your modem is controlled by semi-permanent firmware, which is stored in flash memory. Multi-Tech's firmware is nonvolatile; that is, it remains stored in memory when the modem is turned off and can be upgraded as new features are added.

Multi-Tech's *Flash Wizard* can be downloaded from Multi-Tech's FTP site and is available on CD. Use this Flash Wizard for upgrading your firmware. Documentation for using the Flash Wizard is included with the wizard.

The following table shows you which products support the Flash Wizard.

SocketModem MT5600SMI	No Flash Upgrade. Can use ASCII upload via terminal emulator; i.e., HyperTerminal.
SocketModem MT5656SMI	No Flash Upgrade. Can use ASCII upload via terminal emulator; i.e., HyperTerminal.
SocketModem MT5634SMI	Flash Wizard Software for Windows® Flash Wizard Software for Linux Multi-Tech Flash Wizard Protocol
SocketModem MT9234SMI	Flash Wizard Software for Windows® Flash Wizard Software for Linux Multi-Tech Flash Wizard Protocol
SocketModem MT2456SMI	No Flash Upgrade. Can use ASCII upload via terminal emulator; i.e., HyperTerminal.
SocketModem MT2456SMI-IP	XMODEM serial port upgrade or TFTP Ethernet upgrade. See the next page for information about using the XMODEM upgrade.
SocketEthernet IP MTXCSEM	XMODEM serial port upgrade or TFTP Ethernet upgrade. See the next page for information about using the XMODEM upgrade.
SocketEthernet IP MT100SEM	Flash Wizard Software for Windows® Flash Wizard Software for Linux Can use ASCII upload via terminal emulator; i.e., HyperTerminal.
SocketModem ISDN MT128SMI	Flash Wizard Software for Windows® Flash Wizard Software for Linux Multi-Tech Flash Wizard Protocol
SocketModem GPRS MTSMC-G	Do not use the Flash Wizard for the wireless modems. Contact Multi-Tech for wireless modem firmware upgrade directions.
SocketModem CDMA MTSMC-C	Do not use the Flash Wizard for the wireless modems. Contact Multi-Tech for wireless modem firmware upgrade directions.
SocketModem EDGE MTSMC-E	Do not use the Flash Wizard for the wireless modems. Contact Multi-Tech for wireless modem firmware upgrade directions.
SocketWireless Wi-Fi MT800SWM	XMODEM serial port upgrade. See the next page for information about using the XMODEM upgrade.
SocketWireless Bluetooth MTS2BTSMI	Do not use the Flash Wizard for the wireless modems. Contact Multi-Tech for wireless modem firmware upgrade directions.

Flash Wizard Software for Windows®: ftp://ftp.multitech.com/Utilities/FlashWizard/

Flash Wizard Software for Linux: http://mtflashwiz.sourceforge.net/

XMODEM Serial Port Upgrade

The SocketEthernet IP Module, for example, contains a 2 MB flash wherein the boot image, the firmware and configuration files are stored in a compressed format. The flash can easily be upgraded both locally as well as remotely.

Serial Port Upgrade

The flash of the SocketEthernet IP can be upgraded locally through serial port using the upload feature of serial applications.

Serial Port Configuration

The default serial port parameters should be:

Data length – 8 bits

Parity – None

Stop bits – 1

Baud-rate of the serial port to which the SocketEthernet IP Module is connected should be set to 115200 bps for proper operation.

Example of a Serial Flash Upgrade

Following steps explain the procedure to upgrade a flash using the serial COM port (serial flash upgrade).

Connect the SocketEthernet IP Module to a PC COM Port.

- Open an application through which we can access the serial device (e.g., Meterm, zoc, hyperterm).
- Reboot the SocketEthernet IP Module.
- Wait for the boot message and prompt “press d to download” to appear.
- Press **d** when prompted.
- Select the **XMODEM** Protocol from the Terminal application.
- Choose a file (MTXCSEM-TFTP-…) file to be uploaded.
- Perform a file upload.

The SocketEthernet IP Module reboots and will be up after a few seconds (10-15 seconds).

TFTP Ethernet Upgrade

The flash can be upgraded remotely through the Ethernet using TFTP.

The SocketEthernet IP Module flash contains two main files, which are required for an upgrade.

1. **Binary File**
   The binary file contains the firmware of the Module.
   The name of this binary file would be in the following format.
   MTXCSEM-TFTP-v<version>w-<date in ddMmmyyyy format>

2. **Gun-zipped http.tar.gz File**
   This contains the HTML pages of the serial device and other files related to it, such as **http-host-param** (**http page configuration file**).
   The name of this tar file would always be **http.tar.gz**

Enabling TFTP Server

Enable TFTP server on SocketEthernet IP Module by issuing the following command:

```
# set ip tftp enable
OK
```

Example of an Ethernet Flash Upgrade

The IP module can be remotely upgraded over a network. Make sure a TFTP client is already installed on the machine. The following steps explain the method to perform flash upgrade from Ethernet.

- Make sure the SocketEthernet IP Module is reachable on the LAN.
- Perform a TFTP to the SocketEthernet IP Module from a TFTP client.
  – Set binary mode ON. **Note:** This step is very important.
  – Binary
- Put the binary file.
  – put <binary filename>
- Exit the TFTP session.
  – Quit

The SocketEthernet IP Module reboots after it has been successfully upgraded.

Multi-Tech Systems, Inc. Flash Programming Protocol

This information is provided exclusively for the users of Multi-Tech Systems, Inc. SocketModems, specifically the MT5634SMI and the MT128SMI. Multi-Tech Systems, Inc. SocketModem owners have the right to use, modify, and incorporate this code into other products provided they include the Multi-Tech Systems, Inc. notice and the associated copyright notice with any such product.

Copyright (C) Multi-Tech Systems, Inc. 1995
All Right Reserved
The flash programming protocol is provided "AS IS" without warranty.

Important: When interacting with the boot code, it is possible to make the modem inoperable. Use extreme caution.

Programming the Modem

There are two ways to start flash programming a modem. It can be programmed

1. From "AT" mode
2. When the modem powers up.

The following table shows how a modem is programmed.

DTE	Modem	Comments
AT*FS\r		This effectively "restarts" the modem so that it enters the boot code.
Handshake Sequence		
M's		Many M's are sent (10 milliseconds apart) at 19200 baud. This is where the handshake starts if the modem is just powered up.
	U	U is sent at 19200 baud if M's are received within 100 milliseconds of power up. If the M's are not received within 100 milliseconds, then the modem starts up normally. If the AT*FS command is used, then you have 1 second (1000mS) to perform the handshake.
D		Sent at 19200 baud.
	M	M if can receive at 9600/19200/38400/57600/115200
	I|J|K|L|M	I if modem will be programmed at 9600 J if modem will be programmed at 19200 K if modem will be programmed at 38400 L if modem will be programmed at 57600 M if modem will be programmed at 115200
	\r\nOK\r\n	Modem is ready to be programmed
Program Sequence: **DTE**	**Modem**	**Comments**
ATFLP\r		Request to the modem to program
	G	Modem is ready for next program packet
[Length High]		High byte of data packet length
[Length Low]		Low byte of data packet length Packet lengths can be up to 4096 bytes in size for most boot code versions
[Address High]		High byte of program address
[Address Middle]		Middle byte of program address
[Address Low]		Low byte of program address Addresses are 3 byte values with a range of 00000h-FFFFFh
[Data Bytes]		These are the data bytes to be programmed at the address specified above. They must be the same number of bytes as specified above.
[Checksum]		This checksum is generated by exclusive ORing together all of the Data Bytes (do not include the Length or Address bytes in that calculation).
	\nOK\r\n \nERROR\r\n	If bytes are programmed and verified. If verify fails or checksum is bad. Retry the block 3 times on an ERROR.
….	….	More of the above sequence until all the data bytes have been sent to the modem.
ATFLEND\r		This ends programming and restarts the modem.

Other Supported Boot Code Commands

2.1	ATI0 -	returns 000 or 247 for ISDN
2.2	ATI1 -	returns boot code version number MM.mmn where MM = unique code for each different platform that has boot code mm = version number of boot code n = version letter of the boot code Examples: 2.05e, 2.12d, 35.15
	ATI4-	Boot code date and time.

Other Programming Concerns

1. The values programmed into Addresses 0000h, 0001h and 0002h should always be forced to C3h 00 01 (i.e., JP 100h).

   This is because the boot code starts at address 100h, while all normal modem code starts at 200h. By allowing 0000h to be programmed to a jump value other than 0100h, the boot code would be bypassed and no further upgrades could occur.
2. Addresses 0100h-01FFh through 70000h-7FFFFh should not be allowed to be programmed under normal circumstances, as this is the main body of the boot up code.
3. The packets sent to the modem must be presorted by address and aligned on 128 byte boundaries (i.e., each packet must start on an address that is a multiple of 128).
4. The packets should also be a minimum of 128 bytes with the non-programmed bytes set to the hex value of FF.
5. The packets sent to the modem must not span a 4K boundary (i.e., start the packet before it and go over the boundary in the middle of the packet).
6. The 10-millisecond delay between M's at the beginning of the handshake is so that the modem can sync up to the start bit. If the M's are sent one right after another, a data bit might be mistaken as a start bit.
7. Multi-Tech firmware files are in Intel Hex Format and must be read in and formatted into 128-4096 byte blocks before being sent to the modem.

Information about the Intel Hex Format

An Intel Format Hex File is a text file consisting of "records", one per line, that start with a ":" character and include only digits 0-9 and letters A-F. There are three different record types: Extended Address Records, Data Records, and End of File Records.

Data records contain the actual data that is to be programmed into a device. The address contained in the data record needs to be combined with an extended address (by adding the extended address shifted four bits left to the data record address) to determine the actual programming address for the data. If no extended address record is before a given data record in the file, then the extended address value is assumed to be zero.

Data Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count "NN"		Maximum value is FF (which is 255 data bytes). Typical is 20h which causes the hex record to fit in 80 columns.
4-7	Address	"XXXX"	Lower 16 bits of 20 bit address, most significant byte first. This must be added to Extended Address left shifted four bits.
8-9	Record Type	"00"	Data Record
10+N	Data Bytes	"YY..YY"	The data bytes in hex. Each byte is two characters.
NN+1,2	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values.
NN+3,4	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example Data Record in Intel Format :2000A0005BB66DDBB66CD8B060C183060D1B366DDBB66DDBB76FDFBF7EFDFBF6EDDBB66DD4			

Extended Address Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count	"02"	Always 2 bytes for this record type
4-7	Address	"0000"	Not used for this record type (must be zero)
8-9	Record Type	"02"	Extended Address Record
10-13	Extended Address	"EEEE"	Top 16 bits of 20 bit address, most significant byte first
14-15	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values
16-17	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example Extended Address Record in Intel Format :020000021000EC			

End of File Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count	"00"	Always 2 bytes for this record type
4-7	Address	"0000"	Transfer Address (usually be zero)
8-9	Record Type	"01"	End of File Record
10-11	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values
12-13	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example End of File in Intel Format :00000001FF			

Account Activation for Wireless Products

Pre-Configured Multi-Tech Products

Each Multi-Tech wireless product (except for the MTCBA-C-N1 and N9) has been pre-configured to operate on a specific wireless network, such as Sprint, Verizon, and Cingular.

However, before you can begin to use the modem, you must set up a wireless data account with your wireless network provider. Then, follow the activation procedures covered on the Activation Notices available from Multi-Tech.

If you are not currently working with an activation agent, Multi-Tech can simplify the process and set up an account for you. As a certified national **Cingular** Activation Agent and a certified national **Sprint** Activation agent, Multi-Tech offers you the same competitive data and voice plans provided by Cingular and Sprint. Call Multi-Tech at 888-288-5470 or 763-785-3500, and let Multi-Tech take care of your activation requirements.

Certifications, Approvals, Compliance, and Requirements

Wireless Approvals (GSM, CDMA)

The Multi-Tech SocketModem is Industry and/or Carrier Approved as an End Product modem. When integrated and used with an antenna system that was part of the Multi-Tech modem certification, no additional approvals or certification are required (however, CDMA has a few exceptions) for the device you develop as long as the following are met:

- **PTCRB Requirements:**
  The antenna system **cannot** be altered.
- **Model Identification:**

  IMPORTANT
  When the wireless carrier asks you to provide the modem's model identification, give the Multi-Tech wireless model identification, not the identification of the host device. See the label example below.

  The Multi-Tech model identification allows the carrier to verify the modem as one of its approved models.

  This information is located on the modem's label.

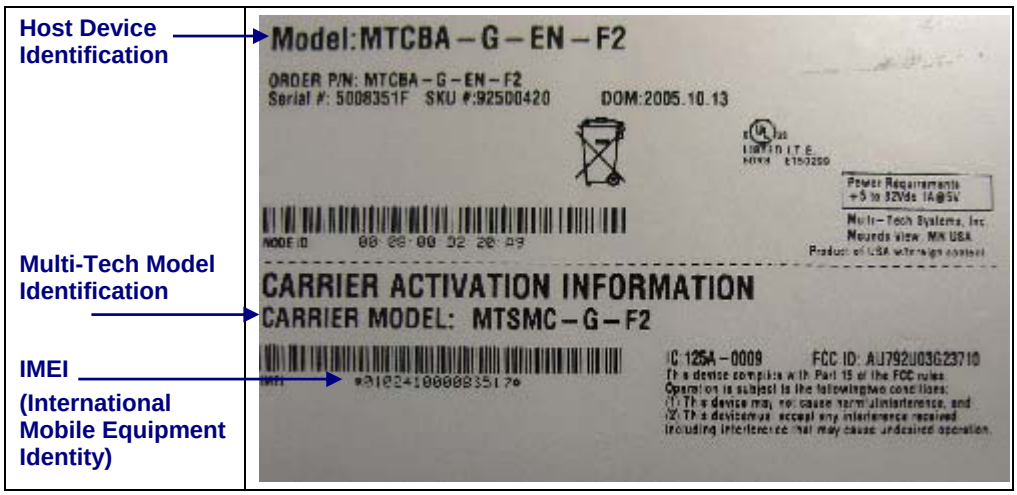
  Example:

  The following is an example of Multi-Tech's wireless model identifcation:

  MTSMC-G-F2 – Multi-Tech wireless GPRS model identification.

  MTSMC-C-N2 – Multi-Tech wireless CDMA model identification.

  MTSMC-E – Multi-Tech wireless EDGE model identification.


Host Device Identification
Multi-Tech Model Identification
IMEI
(International Mobile Equipment Identity)
Model:MTCBA – G – EN – F2
ORDER P/N: MTCBA – G – EN – F2
Serial #: 5008351F SKU #:92500420
DOM:2005.10.13
CARRIER ACTIVATION INFORMATION
CARRIER MODEL: MTSMC – G – F2
IC:125A – 0009
FCC ID: AU792U03G23710

- **Other Information the Wireless Carrier Asks You to Provide:**

  For CDMA modules: The modem's 8-character ESN (Electronic Serial Number) number printed next to the barcode on the modem.

  For GSM modules: The modem's 15-character IMEI (International Mobile Equipment Identity) number printed on the modem's label.

Note: See the Wireless product chapters for qualified antenna systerms.

Telecom Approvals for Analog Dial-up

Multi-Tech's Analog Dial-up Global* SocketModems are designed and approved for connection to the public switched telephone network in more than 50 countries or regions worldwide. Multi-Tech's SocketModems have been approved as host independent, which means our certification efforts can be transferred directly to your end product with proper labeling on the OEM equipment. Multi-Tech supports our approvals by supplying our customers with supporting documentation and offering a compliance label with country or regional approval logos and approval numbers to be attached to an end product.

The following is a list of countries or regions that Multi-Tech completes testing and obtains** certification test reports or certificates at or near the initial release of the product. After the initial release, the product may be tested and certified for other countries or regions. Check the Multi-Tech Systems, Inc. Web site at

http://www.multitech.com/products/info/approvals/smi.asp or contact Multi-Tech at oemsales@multitech.com to obtain a current list of approvals for the SocketModem.

Countries or Regions			
Argentina	France	Liechtenstein	Singapore
Australia	Germany	Lithuania	Slovakia Republic
Austria	Greece	Luxembourg	Slovenia
Belgium	Hong Kong, S.A.R. of China	Malaysia	South Africa
Brazil	Hungary	Malta	Spain
Bulgaria	Iceland	Mexico	Sweden
Canada	India	Netherlands	Switzerland
Chile	Indonesia	New Zealand	Taiwan
China	Ireland	Norway	Thailand
Cyprus	Israel	Philippines	Turkey
Czech Republic	Italy	Poland	United Kingdom
Denmark	Japan	Portugal	United States
Estonia	Korea	Romania	
Finland	Latvia	Russia	

The above list is our target set of countries or regions in which the global* SocketModems are approved. Many of the approvals are completed at the time the product is released to market; whereas, others may take additional months to complete the approval.

***** Refer to each chapter for Product Ordering Information identifying the modem as Global or Regional.

****** Some countries or regions have special import requirements that require us to facilitate additional paperwork application in partner with our customers. Contact Technical Support or Multi-Tech at oemsales@multitech.com for more information.

Note About Setting Country/Regional Codes: Country or Regional Codes are usually set through AT Commands. See each product's AT Command guide.

Labeling Requirements

United States Labeling Requirements (for Dial-Up Modems)

Telecom does not apply to all products. For example, this is not applicable for the SocketModem GPRS and CDMA products.

Approved terminal equipment and approved protective circuitry shall prominently display the following information using the format shown below:

- Responsible party
- Product Identification
- Equipment Code
- Ringer Equivalence
- Ringer Type
- Indication that the product meets the requirements of FCC Part 68

The information required by the first five items shall correspond to the records in the ACTA (America's Carriers Telecommunications Association) database of approved equipment. The required information shall be encoded in the following format:

US: AAAEQ##TXXX

Where:
US: Is a fixed field that indicates the equipment meets all requirements of 47 CFR Part 68, including the requirements published by ACTA (America's Carriers Telecommunications Association).

AAA is the responsible party's Grantee Code obtained previously from the FCC's Common Carrier Bureau or currently from ACTA.

EQ Is an Equipment Code indicating to the Service Provider any special signal handling or billing requirements. The Equipment codes are listed in Annex A (normative).

is the Ringer Equivalence Number without a decimal point (e.g. REN of 1.0 = 10, REN of 0.3 = 03). In the case of a "Z" ringer, ZZ shall appear. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied then "NA" shall appear.

T is the ringer type letter associated with the Ringer Equivalence Number, in accordance with the technical requirements. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied, the letter "N" shall appear.

XXX Is a product identifier, unique when combined with the responsible party's Grantee Code, of at least one and up to nine alphanumeric characters (including one or more dashes (-) if desired. A dash shall not appear as the first or last character nor shall the identifier consist entirely of dashes). The responsible party shall define this identifier.

Label Physical Characteristics

The information required above shall be permanently affixed and legible without magnification. It may be etched, engraved, stamped, indelibly printed, or otherwise permanently marked. Alternatively, the required information may be permanently marked on a nameplate of metal, plastic or other material fastened to the enclosure by welding, riveting or with a permanent adhesive. Such a nameplate shall be able to last for the expected lifetime of the equipment and shall not be readily detachable.

Labeling Continuity and Changes

The labeling content and format requirements in effect when a product was approved shall be effective for the life of the product. The labeling content and format requirements in effect at approval shall also continue to be effective for modified products. However, the responsible party shall have the option of conforming a product's labeling to current content and format requirements at any time.

Other Label Requirements

The label shall be placed in one of the following locations in a location where it can be found after installation:

- on an outside surface
- inside a readily available access door or panel
- on another readily accessible surface

For example, the label should not be placed on the rear of a permanently wall-mounted device in a manner such that it is not readily accessible.

Canadian Labeling Requirements (for Dial-Up Modems)

The following requirements are established under section 69.3 of the *Telecommunications Act* for purposes of section 5 of the *Telecommunications Apparatus Regulations*.

Registered equipment shall bear the following identifying marks, and the Declaring Party shall ensure that these marks are permanently affixed to the equipment:

(a) The registration number — Specifications of this mark are given in the document: *Self-Marking of the Certification/Registration Number on Terminal Equipment — Application Procedure and Agreement*; and

(b) The model identification number under which the product was registered.

A statement of compliance with Industry Canada requirements, such as the one given below, shall accompany each unit of equipment whether registered under this procedure or previously certified:

"This product meets the applicable Industry Canada technical specifications"

For terminal equipment intended for connection to loop-start or ground-start interfaces, the Ringer Equivalence Number (REN) must be calculated as per Section 1.8 of CS-03, Part I. A REN higher than that determined may be assigned by manufacturers to allow for production variations. The REN must be marked on the terminal equipment itself or added to the note below. A note similar to the following shall accompany each unit of equipment whether registered under this procedure or previously certified:

"The Ringer Equivalence Number is an indication of the maximum number of devices allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the RENs of all the devices does not exceed five".

Pursuant to section 69.3 of the *Telecommunications Act*, certified or self-declared TE will bear a valid identifying certification number or registration number. The marking of the certification or registration number on the product shall be as follows:

(a) TAC holder/DP will be responsible for permanently affixing the certification/registration number on the TE. The certification/registration number (see example below) identifies Certified or self-declared TE to the public, representatives of the telecommunications common carriers, the Department, and other interested parties. The letter height must be no less than 1.5 mm and the letters must be legible without magnification.

(b) For integrated devices, e.g. a modem or one that is intended to become a sub-assembly of host equipment e.g. a data terminal, computer etc. that are designed to interface directly with the network, the certification/registration number shall be affixed to the integrated device itself.

(c) The certification/registration number for a packaged TE will denote that the total package has been registered. However, the marking will normally be placed on that unit of the package which connects to the network; e.g., in a PBX the marking will be placed on the common equipment which connects to the network, rather than on plug-in components which may be added later. The Terminal Equipment List will show the common equipment but not the standard station apparatus or any proprietary station apparatus.

(d) The marking format of the certification/registration number is as follows:

IC: XXXXXX-YYYYYYYY

Where:

- The letters "IC" have no other meaning or purpose than to identify the Industry Canada certification/registration number, and
- “XXXXXX-YYYYYYYY” is the certification/registration number; “XXXXXX” is the Company Number[1] (CN); it consists of up to six alphanumeric characters (A-Z, 0-9) assigned by Industry Canada; and “YYYYYYYY” is the Unique Product Number (UPN); it consists of up to eight alphanumeric characters (A-Z, 0-9) assigned by the applicant. Other characters, (such as & # *-) may not be used. Alphabetic characters must be capitalized.

[1] **Note**: The Company Number of registered equipment ends with an alphabetic character.

(e) Certification Numbers granted prior to the implementation of the above marking format are grandfathered.

(i) For previously certified TE, the self-marking format shall consist of the old certification number preceded by “IC:” For example, if the certification number is “123 1234 A”, then the self-mark would read “IC: 123 1234 A”.

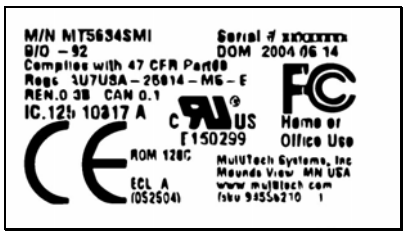
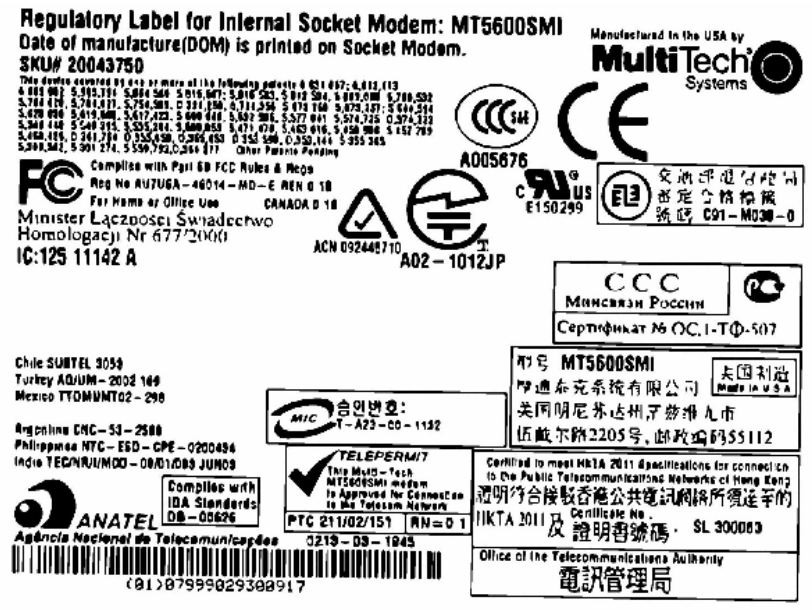
(ii) For a new model that is registered to a family of previously certified TE, the self-marking format shall be: IC: XXXXXX-ZZZZZZZZ

Where:

- “XXXXXX” is the Company Number, as in (d) above; and
- “ZZZZZZZZ” is either the old certification number minus the old company number, or a new Unique Product Number assigned by the applicant. For example, if a new model is registered to the family of products with certification number “123 1234 A”, and that the Company Number for the registration is “123A”, then the self-mark for this new model would read “IC: 123A-1234 A”. If the applicant decides to replace “1234 A” with a new UPN, say “5678", then the self-mark would read “IC: 123A-5678".

Label Examples (for Dial-Up SocketModems)

Note: These do not apply to the Wireless GPRS and CDMA products.

	This label shows the modem model (M/N), build option (B/O), date of manufacture (DOM), serial number, and North America and European Union regulatory information.
	This is a Telecom compliance label.

Regulatory Compliance Statements

CE

EMC, Safety, and R&TTE Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility;
and
Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;
and
Council Directive 1999/5/EC of 9 March on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

International Modem Restrictions

Some dialing and answering defaults and restrictions may vary for international modems. Changing settings may cause a modem to become non-compliant with national telecom requirements in specific countries. Also note that some software packages may have features or lack restrictions that may cause the modem to become non-compliant.

EMC Requirements for the United States

FCC Part 15 Regulation

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Plug the equipment into an outlet on a circuit that is different from the one used by the receiver.
Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC rules. Operation of this device is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

WARNING – Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

EMC Requirements for Industry Canada

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Reglement Canadien sur le matériel brouilleur.

New Zealand Telecom Warning Notice

1. The grant of a Telepermit for any item of terminal equipment indicates only that Telecom has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all of Telecom's network services.
   This equipment is not capable under all operating conditions of correct operating conditions of correct operation at the higher speed which it is designated. 33.6 kbps and 56 kbps connections are likely to be restricted to lower bit rates when connected to some PSTN implementations. Telecom will accept no responsibility should difficulties arise in such circumstances.
2. Immediately disconnect this equipment should it become physically damaged, and arrange for its disposal or repair.
3. This modem shall not be used in any manner which could constitute a nuisance to other Telecom customers.
4. This device is equipped with pulse dialing, while the Telecom standard is DTMF tone dialing. There is no guarantee that Telecom lines will always continue to support pulse dialing.
   Use of pulse dialing, when this equipment is connected to the same line as other equipment, may give rise to 'bell tinkle' or noise and may also cause a false answer condition. Should such problems occur, the user should NOT contact the Telecom Faults Service.
   The preferred method of dialing is to use DTMF tones, as this is faster than pulse (decadic) dialing and is readily available on almost all New Zealand telephone exchanges.
5. Warning Notice: No '111' or other calls can be made from this device during a mains power failure.
6. This equipment may not provide for the effective hand-over of a call to another device connected to the same line.
7. Some parameters required for compliance with Telecom's Telepermit requirements are dependent on the equipment (PC) associated with this device. The associated equipment shall be set to operate within the following limits for compliance with Telecom's Specifications:
   For repeat calls to the same number:
   - There shall be no more than 10 call attempts to the same number within any 30 minute period for any single manual call initiation, and
   - The equipment shall go on-hook for a period of not less than 30 seconds between the end of one attempt and the beginning of the next attempt.

   For automatic calls to different numbers:
   - The equipment shall be set to ensure that automatic calls to different numbers are spaced such that there is no less than 5 seconds between the end of one call attempt and the beginning of another.
8. For correct operation, total of the RN's of all devices connected to a single line at any time should not exceed 5.

South African Statement

This modem must be used in conjunction with an approved surge protection device.

Other

The above country-specific examples do not cover all countries with specific regulations; they are included to show you how each country may differ. If you have trouble determining your own country's requirements, check with Multi-Tech's Technical Support for assistance.

Waste Electrical and Electronic Equipment Statement

Note to OEMs: The statement is included for your information and may be used in the documentation of your final product applications.

WEEE Directive

The WEEE directive places an obligation on EU-based manufacturers, distributors, retailers, and importers to take-back electronics products at the end of their useful life. A sister Directive, ROHS (Restriction of Hazardous Substances) complements the WEEE Directive by banning the presence of specific hazardous substances in the products at the design phase. The WEEE Directive covers all Multi-Tech products imported into the EU as of August 13, 2005. EU-based manufacturers, distributors, retailers and importers are obliged to finance the costs of recovery from municipal collection points, reuse, and recycling of specified percentages per the WEEE requirements.

Instructions for Disposal of WEEE by Users in the European Union

The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or where you purchased the product.

July, 2005

Restriction of the Use of Hazardous Substances (RoHS)

Multi-Tech Systems, Inc.
Certificate of Compliance

2002/95/EC

Multi-Tech Systems Inc. confirms that MTxxxxSMI, MTSMC-G-F1, MTxxxxSEM, MTIFM, and MTxxxSWM now comply with the chemical concentration limitations set forth in the directive **2002/95/EC** of the European Parliament (Restriction Of the use of certain Hazardous Substances in electrical and electronic equipment - **RoHS**)

These Multi-Tech Systems, Inc. products do not contain the following banned chemicals:

Lead, [Pb] > 1000 PPM

Mercury, [Hg] > 1000 PPM

Hexavalent Chromium, [Cr+6] > 1000 PPM
Cadmium, [Cd] > 100 PPM

Polybrominated Biphenyl, [PBB] > 1000 PPM

Polybrominated Diphenyl Ether, [PBDE] > 1000 PPM

Moisture Sensitivity Level (MSL) =1

Tin Whisker Growth = None detected

Maximum Soldering temperature = 260C (wave only)

Notes:

1. Lead usage in some components is exempted by the following RoHS annex; therefore, higher lead concentration would be found in some modules (>1000ppm).
    a. Lead in high melting temperature type solders (i.e., tin-lead solder alloys containing more than 85% lead).
    b. Lead in electronic ceramic parts (e.g., piezoelectronic devices).
2. Moisture Sensitivity Level (MSL) – Analysis is based on the components/material used on the board.
3. Tin Whisker Study was done per NEMI guidelines (Elevated temperature cycle of 60°C and non-condensing relative humidity of 87% exposed to this environment for 1000 hours).

Information on HS/TS Substances According to Chinese Standards

In accordance with China's Administrative Measures on the Control of Pollution Caused by Electronic Information Products (EIP) # 39, also known as China RoHS, the following information is provided regarding the names and concentration levels of Toxic Substances (TS) or Hazardous Substances (HS) which may be contained in Multi-Tech Systems Inc. products relative to the EIP standards set by China's Ministry of Information Industry (MII).

Name of the Component	Hazardous/Toxic Substance/Elements					
	Lead (PB)	Mercury (Hg)	Cadmium (CD)	Hexavalent Chromium (CR6+)	Polybrominated Biphenyl (PBB)	Polybrominated Diphenyl Ether (PBDE)
Printed Circuit Boards	O	O	O	O	O	O
Resistors	X	O	O	O	O	O
Capacitors	X	O	O	O	O	O
Ferrite Beads	O	O	O	O	O	O
Relays/Opticals	O	O	O	O+	O	O
ICs	O	O	O	O	O	O
Diodes/ Transistors	O	O	O	O	O	O
Oscillators and Crystals	X	O	O	O	O	O
Regulator	O	O	O	O	O	O
Voltage Sensor	O	O	O	O	O	O
Transformer	O	O	O	O	O	O
Speaker	O	O	O	O	O	O
Connectors	O	O	O	O	O	O
LEDs	O	O	O	O	O	O
Screws, Nuts, and other Hardware	X	O	O	O	O	O
AC-DC Power Supplies	O	O	O	O	O	O
Software / Documentation CDs	O	O	O	O	O	O
Booklets and Paperwork	O	O	O	O	O	O
Chassis	O	O	O	O	O	O

X Represents that the concentration of such hazardous/toxic substance in all the units of homogeneous material of such component is higher than the SJ/Txxx-2006 Requirements for Concentration Limits.

O Represents that no such substances are used or that the concentration is within the aforementioned limits.

Information on HS/TS Substances According to Chinese Standards (in Chinese)

依照中国标准的有毒有害物质信息

根据中华人民共和国信息产业部 (MII) 制定的电子信息产品 (EIP) 标准－中华人民共和国《电子信息产品污染控制管理办法》（第 39 号），也称作中国 RoHS，下表列出了 Multi-Tech Systems, Inc. 产品中可能含有的有毒物质（TS）或有害物质 (HS) 的名称及含量水平方面的信息。

成分名称	有害/有毒物质/元素					
	铅 (PB)	汞 (Hg)	镉 (CD)	六价铬 (CR6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板	O	O	O	O	O	O
电阻器	X	O	O	O	O	O
电容器	X	O	O	O	O	O
铁氧体磁环	O	O	O	O	O	O
继电器/光学部件	O	O	O	O	O	O
IC	O	O	O	O	O	O
二极管/晶体管	O	O	O	O	O	O
振荡器和晶振	X	O	O	O	O	O
调节器	O	O	O	O	O	O
电压传感器	O	O	O	O	O	O
变压器	O	O	O	O	O	O
扬声器	O	O	O	O	O	O
连接器	O	O	O	O	O	O
LED	O	O	O	O	O	O
螺丝、螺母以及其它五金件	X	O	O	O	O	O
交流-直流电源	O	O	O	O	O	O
软件/文档 CD	O	O	O	O	O	O
手册和纸页	O	O	O	O	O	O
底盘	O	O	O	O	O	O

X 表示所有使用类似材料的设备中有害/有毒物质的含量水平高于 SJ/Txxx-2006 限量要求。

O 表示不含该物质或者该物质的含量水平在上述限量要求之内。

Multi-Tech Warranty Statement

Multi-Tech Systems, Inc., (hereafter "MTS") warrants that its products will be free from defects in material or workmanship for a period of two, five, or ten years (depending on model) from date of purchase, or if proof of purchase is not provided, two, five, or ten years (depending on model) from date of shipment.

MTS MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by Customer or any party without MTS's written authorization, or used in any manner inconsistent with MTS's instructions.

MTS's entire obligation under this warranty shall be limited (at MTS's option) to repair or replacement of any products which prove to be defective within the warranty period or, at MTS's option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS's factory — transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PRICE FOR DEFECTIVE PRODUCTS.

Repair Procedures for U.S. and Canadian Customers

In the event that service is required, products may be shipped, freight prepaid, to our Mounds View, Minnesota factory:

Multi-Tech Systems, Inc.
2205 Woodale Drive
Mounds View, MN 55112 U.S.A.
Attn: Repairs, Serial # _____

A Returned Materials Authorization (RMA) is not required. Return shipping charges (surface) will be paid by MTS to destinations in U.S. and Canada.

Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a payment in advance is required. Acceptable means of payment include credit card, wire transfer or a check in U.S. dollars drawn on a U.S. Bank.

For out of warranty repair charges, go to COMPANY/Policies/warranty/

Extended two-year overnight replacement service agreements are available for selected products. Please call MTS customer service at (888) 288-5470 or visit our web site at /PARTNERS/Programs/overnight_replacement/ for details on rates and coverages.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department at (800) 972-2439 or email support@multitech.com. Please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (800) 328-9717 or (763) 717-5631, or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Customers (Outside U.S.A. and Canada)

Your original point-of-purchase Reseller may offer the quickest and most economical repair option for your Multi-Tech product. You may also contact any Multi-Tech sales office for information about the nearest distributor or other repair service for your Multi-Tech product. The Multi-Tech sales office directory is available at www.multitech.com/PARTNERS/Channels/offices/

In the event that factory service is required, products may be shipped, freight prepaid to our Mounds View, Minnesota factory. Recommended international shipment methods are via Federal Express, UPS or DHL courier services, or by airmail parcel post; shipments made by any other method will be refused. Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a payment in advance is required. Acceptable means of payment include credit card, wire transfer or a check in U.S. dollars drawn on a U.S. Bank. Repaired units shall be shipped freight collect, unless other arrangements are made in advance.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department nearest you or email support@multitech.com. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A., or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Distributors

International distributors should contact their MTS International sales representative for information about the repair of Multi-Tech product(s).

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our International Technical Support department at +(763)717-5863. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A. or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Multi-Tech Systems, Inc., (hereafter “MTS”) warrants that its products documented in the *Developer Guide* will be free from defects in material or workmanship for a period of two years from date of purchase; or, if proof of purchase is not provided, two years from date of shipment.

MTS MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by Customer or any party without MTS’s written authorization, or used in any manner inconsistent with MTS’s instructions.

MTS’s entire obligation under this warranty shall be limited (at MTS’s option) to repair or replacement of any products which prove to be defective within the warranty period or, at MTS’s option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS’s factory — transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PRICE FOR DEFECTIVE PRODUCTS.

Chapter 2

SocketModem®

MT5600SMI
MT5656SMI

Chapter 2 – SocketModem (MT5600SMI & MT5656SMI)

Introduction

The Multi-Tech SocketModem creates communication-ready devices by integrating data/fax/voice functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92 or V.34/33.6K data communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

The MT5600SMI/MT5656SMI SocketModem is a standard 64-pin modem used for integrating data communications.

- It is a single-port modem that integrates the controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface.
- It is available with an 8-bit parallel interface.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT5600SMI			
MT5600SMI-32.Rx	V.32bis Serial Data/Fax 5V	Global	
MT5600SMI-L-32.Rx	V.32bis Serial Data/Fax 3.3V	Global	
MT5600SMI-P-32.Rx	V.32bis Parallel Data/Fax 5V	Global	
MT5600SMI-34.Rx	V.34bis Serial Data/Fax 5V	Global	
MT5600SMI-L-34.Rx	V.34bis Serial Data/Fax 3.3V	Global	
MT5600SMI-P-34.Rx	V.34bis Parallel Data/Fax 5V	Global	
MT5600SMI-P-L-34.Rx	V.34bis Parallel Data/Fax 3.3V	Global	
MT5600SMI-X-L-34.Rx	V.34bis Parallel Data/Fax 3.3V (Exclude LED pins)	Global	
MT5600SMI-92.Rx	V.92 Serial Data/Fax 5V	Global	
MT5600SMI-L-92.Rx	V.92 Serial Data/Fax 3.3V	Global	
MT5600SMI-P-92.Rx	V.92 Parallel Data/Fax 5V	Global	
MT5600SMI-P-L-92.Rx	V.92 Parallel Data/Fax 3.3V	Global	
MT5600SMI-X-L-92.Rx	V.92 Parallel Data/Fax 3.3V (Exclude LED pins)	Global	
Telecom Label			
MT5600SMI-LS	MT5600SMI-Global Regulatory Label (50 Pack)	Global	
MT5600SMI-NALTE	MT5600SMI PRC (People's Republic of China) NALTE Regulatory Label	PRC	
MT5656SMI			
MT5656SMI-V-32.Rx	V.32bis Serial Data/Fax, Speakerphone Interface 5V	Global	
MT5656SMI-P-V-32.Rx	V.32bis Parallel Data/Fax, Speakerphone Interface 5V	Global	
MT5656SMI-V-34.Rx	V.34 Serial Data/Fax, Speakerphone Interface 5V	Global	
MT5656SMI-P-V-34.Rx	V.34bis Parallel Data/Fax, Speakerphone Interface 5V	Global	
MT5656SMI-V-92.Rx	V.92 Serial Data/Fax, Speakerphone Interface 5V	Global	
MT5656SMI-P-V-92.Rx	V.92 Parallel Data/Fax, Speakerphone Interface 5V	Global	
Developer Kits			
MTSMI-UDK	SocketModem Serial Developer Kit	Global	
MTSMI-P-UDK	SocketModem Parallel Developer Kit	Global	

How to Read the Product Codes in the Above Table:

32	V.32bis/14.4K data rate	L	3.3V power input (default is 5 V)
34	V.34/33.6K data rate	P	Parallel interface (serial is default)
92	V.92/56K data rate	X	Excludes LED pinouts
V	Speakerphone I/O	UDK	Universal Developer Kit

Other Product Codes:

R*x* "R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketModem (MT5600SMI and MT5656SMI) meets the following specifications:

Category	*Description*
Data Standards	V.92, V.90, V.34, V.32bis, V.32, V.22bis, V.22, V.23, V.21 Bell 212A & Bell 103
Data Format	Serial, 8-bit parallel interface, asynchronous
Character Format	10 bit or 11 bit
Serial/Data Speeds	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps
Client-to-Client Data Rates	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400, 1200, 0-300 bps
Data Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.42bis, MNP 5
Fax Compatibility	V.17, V.29/V.27/V.21
Fax Class	For MT5600SMI: Class 1, 1.0 For MT5656SMI: Class 1, 2
Fax Compression	MH, MR, MMR
Fax Error Correction Mode	EMC
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Dimensions	2.541” L × 1.045” W × 0.68” H (6.45 cm x 2.65 cm x 1.7 cm)
Weight	0.6 oz. (0.017 kg.)
Operating Temperature	0° to +70° C
Storage Temperature	-40º to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	3.3V Serial 5V Serial or Parallel
Power Requirements	**3.3V (MT5600SMI Only)** Typical: 115mA (.38W @ 3.3VDC) Maximum: 116mA (.41W @ 3.6VDC) **5V (MT5600SMI & MT5656SMI)** Typical: 117mA (.58W @ 5VDC) Maximum: 118mA (.61W @ 5.25VDC)
Transmit Level	-11dBm (varies by country)
Receiver Sensitivity	-43 dBm
DAA Isolation	1.5Kv r.m.s. or 2121 VDC at working voltage of 250VAC
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	60 characters
Telephony/TAM	V.253 commands 2-bit and 4-bit ADPCM, 8-bit linear PCM, and 4-bit IMA coding 8 kHz sample rate Concurrent DTMF, distinctive ring, and U.S. Caller ID detection
Certifications & Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 CCC **EMC Approvals** FCC Part 15 (Class B) Canada (Class B) EN 55022 (Class B) EN 55024
Warranty	**2 years**

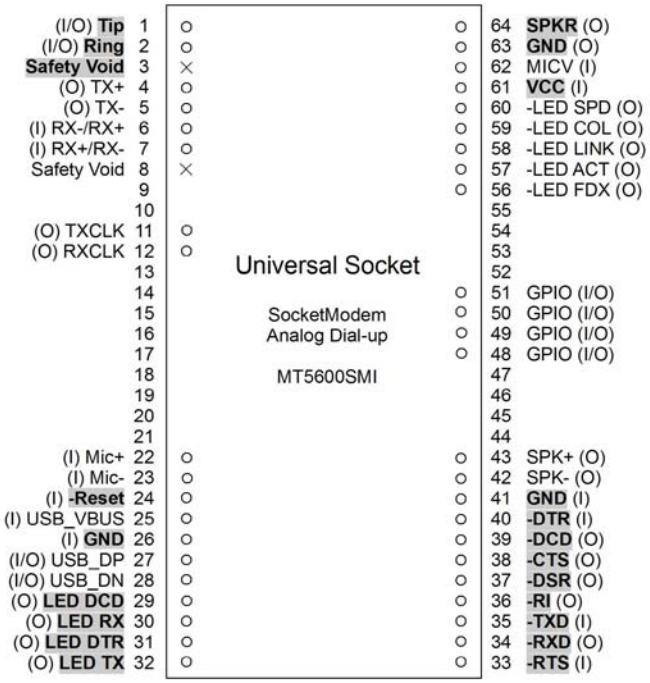
Category	Description
Intelligent Features	V.22bis Fast Connect FastPOS (V.29) Voice send and receive functions LED pin output option DTMF detection and distinctive ring Audio circuit outputs for audio call-progress monitoring Three-number storage for automatic dialing capabilities and non-volatile memory (NoVRAM) to store user profiles Speaker interface for call progress monitoring Full-duplex data transmission over dial-up lines Line quality monitoring and retrain Line protection circuitry included Auto-dial, redial, and auto-answer Extension pickup detection, remote hang-up detection, line-in-use detection, digital PBX detection and protection Pulse or tone dial Call status display Extension pickup detection Remote hang-up detection Digital PBX detection and protection 60-character command line buffering AT command compatibility Global approvals with a single module design Intelligent DAA technology detects line status MT5656SMI supports speakerphone I/O MT5656SMI support U.S. Caller ID

SocketModem Configuration

MT5600SMI Serial Configuration

The serial interface uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: The **bolded, shaded** pins are the **active** SocketModem pins.

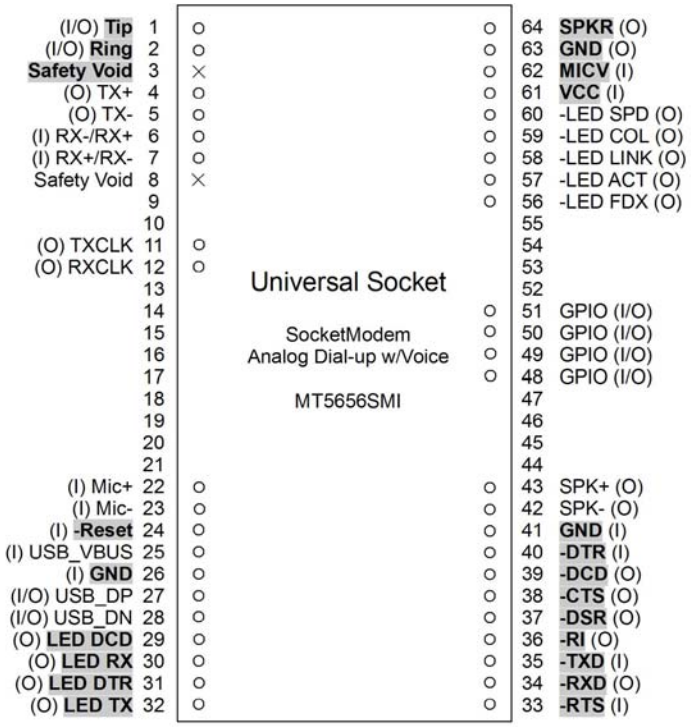


Top View – Serial SocketModem Pinout – MT5600SMI (Available with or without LEDs)

MT5656SMI Serial with Voice Configuration

The serial interface uses a 21-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: The **bolded, shaded** pins are the **active** SocketModem pins.



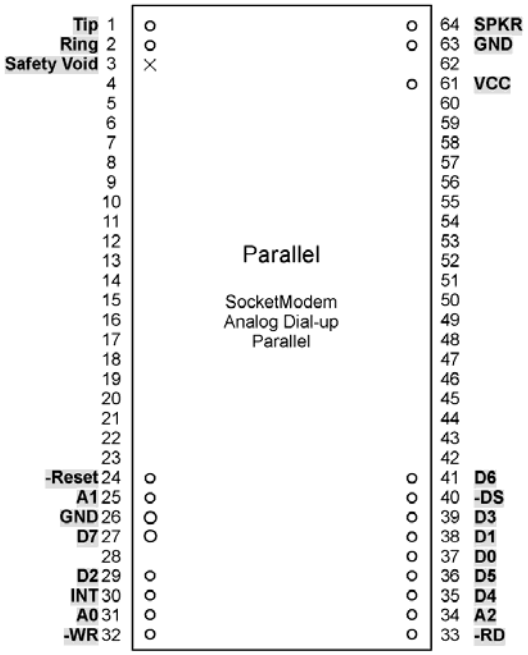
Top View – Serial SocketModem – MT5656SMI Pinout with Voice Configuration

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Parallel Configuration

Note: The parallel configuration is not compatible with the serial universal socket.

The parallel interface SocketModem uses a 22-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, and parallel interface.



Top View
Parallel SocketModem Pinout

Parallel Pin Descriptions

Pin #	Signal Name	In Out Type	Description
1	Tip	I/O	**Telephone Line Interface** – **TIP**
2	Ring	I/O	**Telephone Line Interface** – **RING**
24	–RESET	I	**Modem Reset (CMOS input with pull-up).** The active low –RESET input resets the SocketModem logic and returns the AT command set to the original factory default values or to "stored values" in NVRAM. The modem is ready to accept commands within 6.5 seconds of power-on or reset. Reset must be asserted for a minimum of 15ms.
25	A1	I	**Host Bus Address Line 1**
26	DGND	GND	**Digital Ground**
27	D7	O	**Host Bus Data Line 7**
29	D2	O	**Host Bus Data Line 2**
30	INT	O	**Host Bus Interrupt Line (Active High, Resets on Low)**
31	A0	I	**Host Bus Address Line 0**
32	–WT	I	**Host Bus Write.** When low, allows host to write to SocketModem.
33	–RD	I	**Host Bus Read.** When low, allows host to read from SocketModem.
34	A2	I	**Host Bus Address Line 2**
35	D4	O	**Host Bus Data Line 4**
36	D5	O	**Host Bus Data Line 5**
37	D0	O	**Host Bus Data Line 0**
38	D1	O	**Host Bus Data Line 1**
39	D3	O	**Host Bus Data Line 3**
40	–CS	I	**Host Bus Chip Select (Active Low)**
41	D6	O	**Host Bus Data Line 6**
61	VCC	PWR	**3.3 V or 5 V Supply** (depends upon model).
63	AGND	GND	**Analog Ground.** This is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker** – Call monitor.

Electrical Characteristics

3.3V Serial SocketModem

3.3VDC Characteristics (TA = 0°C to 70°C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	**Input High** Min 2.0V	**Input Low** Max 0.8V	
Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2 mA, Z INT = 120 Ω	**Output High** Min 2.4V	**Output Low** Max 0.5V	
Digital Input Capacitance			**50pF**

3.3 V Parallel SocketModem

Electrical characteristics for Parallel SocketModem devices are presented below.
3.3VDC Characteristics (TA = 0°C to 70°C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DS (40)	**Input High** Min 2.0V	**Input Low** Max 0.8V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33) 8mA Z_{INT} = 50Ω 2 mA Z_{INT} = 120 Ω	**Input High** Min 2.0V	**Input Low** Max 0.8V	
Digital Input/Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27) 2 mA, Z_{INT} = 120 Ω	**Input High** Min 2.0V **Output High** Min 2.4V	**Input Low** Max 0.8V **Output Low** Max 0.5V	
Digital Output INT (30) 2 mA, Z_{INT} = 120 Ω	**Output High** Min 2.4V	**Output Low** Max 0.5V	
Digital Input Capacitance			**50pF**

5V Serial SocketModem

5VDC Characteristics (TA = 0 °C to 50 °C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	**Input High** Min 2V	**Input Low** Max 0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min 2.4V	**Output Low** Max 0.5V	**Current Drive** 15mA
Digital Input Capacitance			**5pF**

5V Parallel SocketModem

5VDC Characteristics (TA = 0 °C to 50 °C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Digital Inputs –DS (40)	**Input High** Min 2V	**Input Low** Max 0.8V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), –WR (32), –RD (33)	**Input High** Min 2V	**Input Low** Max 0.8V	
Digital Input / Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	**Input High** Min 2V	**Input Low** Max 0.8V	**Current Drive** 8mA
Digital Output INT (30)	**Output High** Min 2.4 V	**Output Low** Max 0.5 V	**Current Drive** 8mA
Digital Input Capacitance			**5pF**

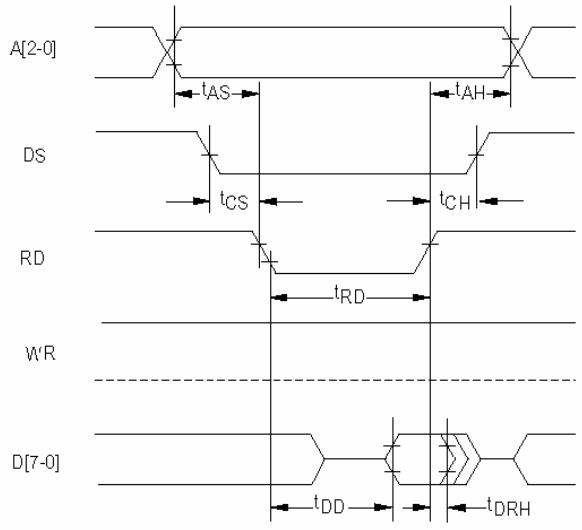
Parallel Host Bus Timing Table

Symbol	Parameter	Min	Max	Units
READ (See Notes)				
t_{AS}	Address Setup	5	-	ns
t_{AH}	Address Hold	10	-	ns
t_{CS}	Chip Select Setup	0	-	ns
t_{CH}	Chip Select Hold	10	-	ns
t_{RD}	RD Strobe Width	45	-	ns
t_{DD}	Read Data Delay	-	25	ns
t_{DRH}	Read Data Hold	5	-	ns
WRITE (See Notes)				
t_{AS}	Address Setup	5	-	ns
t_{AH}	Address Hold	15	-	ns
t_{CS}	Chip Select Setup	0	-	ns
t_{CH}	Chip Select Hold	10	-	ns
t_{WT}	WT Strobe Width	75	-	ns
t_{DS}	Write Data Setup (see Note 4)	-	20	ns
t_{DWH}	Write Data Hold (see Note 5)	5	-	ns

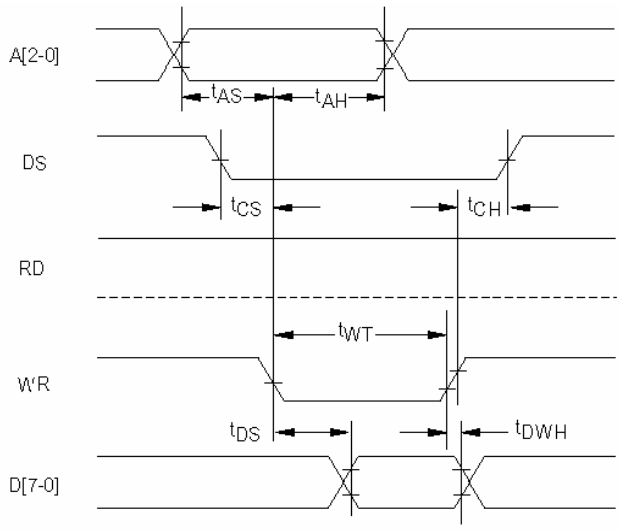
Notes:

1. When the host executes consecutive Rx FIFO reads, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of RD to the falling edge of the next Host Rx FIFO RD clock.
2. When the host executes consecutive Tx FIFO writes, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of WT to the falling edge of the next Host Tx FIFO WT clock.
3. $t_{RD}' + t_{WT} = t_{CYC} + 15$ ns.
4. t_{DS} is measured from the point at which both CS and WT are active.
5. t_{DWH} is measured from the point at which either CS and WT become active.
6. Clock Frequency = 28.224 MHz clock.

Parallel Host Bus – Read



Parallel Host Bus - Write



SocketModem Parallel Interface

The modem supports a 16550A interface in parallel interface versions. The 16550A interface can operate in FIFO mode or non-FIFO mode. Non-FIFO mode is the same as the 16450-interface operation. FIFO mode's unique operations are described in this chapter.

Overview

The modem emulates the 16450/16550A interface and includes both a 16-byte receiver data first-in first-out buffer (RX FIFO) and a 16-byte transmit data first-in first-out buffer (TX FIFO).

FIFO Mode Selected

When FIFO mode is selected in the FIFO Control Register (FCR0 = 1), both FIFOs are operative. Furthermore, when FIFO mode is selected, DMA operation of the FIFO can also be selected (FCR3 = 1).

FIFO Mode Not Selected

When FIFO mode is not selected, operation is restricted to a 16450-interface operation.

Receive Data

Received Data is read by the host from the Receiver Buffer (RX Buffer). The RX Buffer corresponds to the Receiver Buffer Register in a 16550A device. In FIFO mode, the RX FIFO operates transparently behind the RX Buffer. Interface operation is described with reference to the RX Buffer in FIFO and non-FIFO modes.

Transmit Data

Transmit Data is loaded by the host into the Transmit Buffer (TX Buffer). The TX Buffer corresponds to the Transmit Holding Register in a 16550A device. In FIFO mode, the TX FIFO operates transparently behind the TX Buffer. Interface operation is described with reference to the TX Buffer in both FIFO and non-FIFO modes.

Receiver FIFO Interrupt Operation

Receiver Data Available Interrupt

When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (RX Data Available) is enabled (IER0 = 1), receiver interrupt operation is as follows:

1. The Receiver Data Available Flag (LSR0) is set as soon as a received data character is available in the RX FIFO. LSR0 is cleared when RX FIFO is empty.
2. The Receiver Data Available Interrupt code (IIR0-IIR4 = 4h) is set whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. It is cleared whenever the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.
3. The HINT interrupt is asserted whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. HINT interrupt is de-asserted when the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.

Receiver Character Timeout Interrupts

When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (Receiver Data Available) is enabled (IER0 = 1), receiver character timeout interrupt operation is as follows:

1. A Receiver character timeout interrupt code (IIR0-IIR3 = Ch) is set if at least one received character is in the RX FIFO, the most recent received serial character was longer than four continuous character times ago (if 2 stop bits are specified, the second stop bit is included in this time period), and the most recent host read of the RX FIFO was longer than four continuous character times ago.

Transmitter FIFO Interrupt Operation

Transmitter Empty Interrupt

When the FIFO mode is enabled (FCR0 = 1) and transmitter interrupt (TX Buffer Empty) is enabled (IER0 =1), transmitter interrupt operation is as follows:

1. The TX Buffer Empty interrupt code (IIR0-IIR3 = 2h) will occur when the TX Buffer is empty. It is cleared when the TX Buffer is written to (1 to 16 characters) or the IIR is read.
2. The TX Buffer Empty indications will be delayed 1 character time minus the last stop bit time whenever the following occur: THRE = 1 and there have not been at least two bytes at the same time in the TX FIFO Buffer since the last setting of THRE was set. The first transmitter interrupt after setting FCR0 will be immediate.

Register Functional Definitions

The following table delineates the assigned bit functions for the twelve internal registers. The assigned bit functions are more fully defined in the following paragraphs.

Internal Registers

Register No.	Register Name	BIT No. 7	6	5	4	3	2	1	0
7	Scratch Register (SCR)	Scratch Register							
6	Modem Status Register (MSR)	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge of Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
5	Line Status Register (LSR)	RX FIFO Error	Transmitter Empty (TEMT)	Transmitter Buffer Register Empty (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Receiver Data Ready (DR)
4	Modem Control Register (MCR)	0	0	0	Local Loopback	Out 2	Out 1	Request to Send (RTS)	Data Terminal Ready (DTR)
3	Line Control Register (LCR)	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLSO)
2	Interrupt Identify Register (IIR) (Read Only)	FIFOs Enabled	FIFOs Enabled	0	0	Pending Interrupt ID Bit 2	Pending Interrupt ID Bit 1	Pending Interrupt ID Bit 0	“0” if Interrupt Pending
2	FIFO Control Register (FCR) (Write Only)	Receiver Trigger MSB	Receiver Trigger LSB	Reserved	Reserved	DMA Mode Select	TX FIFO Reset	RX FIFO Reset	FIFO Enable
1 (DLAB = 0)	Interrupt Enable Register (IER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
0 (DLAB = 0)	Transmitter Buffer Register (THR)	Transmitter FIFO Buffer Register (Write Only)							
0 (DLAB = 0)	Receiver Buffer Register (RBR)	Receiver FIFO Buffer Register (Read Only)							
1 (DLAB = 1)	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 (DLAB = 1)	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							

IER – Interrupt Enable Register

(Addr = 1, DLAB = 0)

The IER enables five types of interrupts that can separately assert the HINT output signal (See the Interrupt Sources and Reset Control table in the IIR section of this chapter). A selected interrupt can be enabled by setting the corresponding enable bit to a 1, or disabled by setting the corresponding enable bit to a 0. Disabling an interrupt in the IER prohibits setting the corresponding indication in the IIR and assertion of HINT. Disabling all interrupts (resetting IER0 – IER3 to a 0) inhibits setting of any Interrupt Identifier Register (IIR) bits and inhibits assertion of the HINT output. All other system functions operate normally, including the setting of the Line Status Register (LSR) and the Modem Status Register (MSR).

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Bits 7-4 **Not used.**
Always 0.

Bit 3 **Enable Modem Status Interrupt (EDSSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Delta CTS (MSR0), Delta DSR (MSR1), Delta TER (MSR2), or Delta DCD (MSR3) bit in the Modem Status Register (MSR) is a 1. This bit, when a 0, disables assertion of HINT due to setting of any of these four MSR bits.

Bit 2 **Enable Receiver Line Status Interrupt (ELSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Overrun Error (LSR1), Parity Error (LSR2), Framing Error (LSR3), or Break Interrupt (LSR4) receiver status bit in the Line Status Register (LSR) changes state. This bit, when a 0, disables assertion of HINT due to change of the receiver LSR bits 1-4.

Bit 1 **Enable Transmitter Holding Register Empty Interrupt (ETBEI).**
This bit, when a 1, enables assertion of the HINT output when the Transmitter Empty bit in the Line Status Register (LSR5) is a 1.This bit, when a 0, disables assertion of HINT due to LSR5.

Bit 0 **Enable Receiver Data Available Interrupt (ERBFI) and Character Timeout in FIFO Mode.**
This bit, when a 1, enables assertion of the HINT output when the Receiver Data Ready bit in the Line Status Register (LSR0) is a1 or character timeout occurs in the FIFO mode. This bit, when a 0, disables assertion of HINT due to the LSR0 or character timeout.

FCR – FIFO Control Register

(Addr = 2, Write Only)

The FCR is a write-only register used to enable FIFO mode, clear the RX FIFO and TX FIFO, enable DMA mode, and set the RX FIFO trigger level.

Bits 7-6 **RX FIFO Trigger Level**

FCR7 and FCR6 set the trigger level for the RX FIFO (Receiver Data Available) interrupt.

FCR7	FCR6	RX FIFO Trigger Level (Bytes)
0	0	01
0	1	04
1	0	08
1	1	14

Bits 5, 4 Not used

Bit 3 **DMA Mode Select**

When FIFO mode is selected (FCR0 = 1), FCR3 selects non-DMA operation (FCR3 = 0) or DMA operation (FCR3 = 1). When FIFO mode is not selected (FCR0 = 0), this bit is not used (the modem operates in non-DMA mode in 16450 operation).

DMA Operation in FIFO Mode

RXRDY will be asserted with the number of characters in the RX FIFO us equal to or greater than the value in the RX FIFO Trigger Level (IIR0-IIR3 = 4h) or the received character timeout (IIRO-IIR3 = Ch) has occurred. RXTDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are one or more empty (unfilled) locations in the TX FIFO. **TXRDY** will go inactive when the TX FIFO is completely full.

Non-DMA Operation in FIFO Mode

RXRDY will be asserted when there are one or more characters in the RX FIFO. RXRDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are no characters in the TX FIFO. TXRDY will go inactive when the character is loaded into the TX FIFO Buffer.

Bit 2 **TX FIFO Reset**

When FCR2 is a 1, all bytes in the TX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 1 **RX FIFO Reset**

When FCR1 is a 1, all bytes in the RX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 0 **FIFO Enable**

When FCR0 is a 0, 16450 mode is selected and all bits are cleared in both FIFOs. When FCR0 is a 1, FIFO mode (16550A) is selected and both FIFOs are enabled. FCR0 must be a 1 when other bits in the FCR are written or they will not be acted upon.

IIR – Interrupt Identifier Register

(Addr = 2)

The Interrupt Identifier Register (IIR) identifies the existence and type of up to five prioritized pending interrupts. Four priority levels are set to assist interrupt processing in the host. The four levels, in order of decreasing priority, are Highest: Receiver Line Status, 2: Receiver Data Available or Receiver Character Timeout. 3: TX Buffer Empty, and 4: Modem Status.

When the IIR is accessed, the modem freezes all interrupts and indicates the highest priority interrupt pending to the host. Any change occurring in interrupt conditions are not indicated until this access is complete.

Bits 7-6 **FIFO Mode**
These two bits copy FCR0.

Bits 5-4 **Not Used**
Always 0.

Bits 3-1 **Highest Priority Pending Interrupt**
These three bits identify the highest priority pending interrupt (Table below). Bit 3 is applicable only when FIFO mode is selected; otherwise, bit 3 is a 0.

Bit 0 **Interrupt Pending**
When this bit is a 0, an interrupt is pending; IIR bits 1-3 can be used to determine the source of the interrupt. When this bit is a 1, an interrupt is not pending

Interrupt Sources and Reset Control Table

Interrupt Identification Register					Interrupt Set and Reset Functions		
Bit 3 (Note 1)	Bit 2	Bit 1	Bit 0	Priority Level	Interrupt Type	Interrupt Source	Interrupt Reset Control
0	0	0	1	—	None	None	—
0	1	1	0	Highest	Receiver Line Status	Overrun Error (OE) (LSR1), Parity Error (PE) (LSR2), Framing Error (FE) (LSR3), or Break Interrupt (BI) (LSR4)	Reading the LSR
0	1	0	0	2	Received Data Available	Received Data Available (LSR0) or RX FIFO Trigger Level (FCR6-FCR7) Reached[1]	Reading the RX Buffer or the RX FIFO drops below the Trigger Level
1	1	0	0	2	Character Timeout Indication[1]	The RX FIFO contains at least 1 character and no characters have been removed from or input to the RX FIFO during the last 4 character times.	Reading the RX Buffer
0	0	1	0	3	TX Buffer Empty	TX Buffer Empty	Reading the IIR or writing to the TX Buffer
0	0	0	0	4	Modem Status	Delta CTS (DCTS) (MSR0), Delta DSR (DDST) (MSR1), Trailing Edge Ring Indicator (TERI) (MSR3), or Delta DCD (DCD) (MSR4)	Reading the MSR

Notes:
1. FIFO Mode only.

LCR – Line Control Register

(Addr = 3)

The Line Control Register (LCR) specifies the format of the asynchronous data communications exchange.

Bit 7 **Divisor Latch Access Bit (DLAB)**
This bit must be set to a 1 to access the Divisor Latch Registers during a read or write operation. It must be reset to a 0 to access the Receiver Buffer, the Transmitter Buffer, or the Interrupt Enable Register.

Bit 6 **Set Break**
When bit 6 is a 1, the Transmit data is forced to the break condition, i.e., space (0) is sent. When bit 6 is a 0, break is not sent. The Set Break bit acts only on the Transmit data and has no effect on the serial in logic.

Bit 5 **Stick Parity**
When Parity is enabled (LCR3 = 1) and stick parity is selected (LCR5 = 1), the parity bit is transmitted and checked by the receiver as a 0 if even parity is selected (LCR4 – 1) or a 1 if odd parity is selected (LCR4 = 0). When the stick parity is not selected (LCR3 = 0), parity is transmit and checked as determined by the LCR3 and LCR4 bits.

Bit 4 **Even Parity Select (EPS)**
When parity is enabled (LCR3 = 1) and stick parity is not selected (LCR5 = 0), the number of 1s transmitted or checked by the receiver in the data word bits and parity bit is either even (LCR4 = 1) or odd (LCR4 = 0).

Bit 3 **Enable Parity (PEN)**
When bit 3 is a 1, a parity bit is generated in the serial out (transmit) data stream and checked in the serial in (receive) data stream as determined by the LCR4 and LCR5 bits. The parity bit is located between the last data bit and the first stop bit.

Bit 2 **Number of Stop GBITS (STB)**
This bit specifies the number of stop bits in each serial out character. If bit 2 is a 0, one stop bit is generated regardless of word length. If bit 2 is a 1 and 5-bit word length is selected, one and one-half stop bits are generated. If bit 2 is a 1 and 6-, 7-, or 8-bit word length is selected, two stop bits are generated. The serial in logic checks the first stop bit only, regardless of the number of stop bits selected.

Bit 1-0 **Word Length Select (WLS0 and WLS1)**
These two bits specify the number of bits in each serial in or serial out character. The encoding of bits 0 and 1 is:

Bit 1	Bit 0	Word Length
0	0	5 Bits (Not supported)
0	1	6 Bits (Not supported)
1	0	7 Bits
1	1	8 Bits

MCR – Modem Control Register

(Addr = 4)

The Modem Control Register (MCR) controls the interface with modem or data set.

Bit 7-5 **Not used**
Always 0

Bit 4 **Local Loopback**
When this bit is set to a 1, the diagnostic mode is selected and the following occurs:
1. Data written to the Transmit Buffer is looped back to the Receiver Buffer.
2. The DTS (MCR0), RTS (MCR1), Out1 (MCR2), and Out2 (MCR3) modem control register bits are internally connected to the DSR (MSR5), CTS (MSR4), RI (MSR6), and DCD (MSR7) modem status register bits, respectively.

Bit 3 **Output 2**
When this bit is a 1, HINT is enabled. When this bit is a 0, HINT is in the high impedance state.

Bit 2 **Output 1**
This bit is used in local loopback (see MCR4).

Bit 1 **Request to Send (RTS)**
This bit controls the Request to Send (RTS) function. When this bit is a 1, RTS is on. When this bit is a 0, RTS is off.

Bit 0 **Data Terminal Ready (DTR)**
This bit controls the Data Terminal Ready (DTR) function. When this bit is a 1, DTR is on. When this bit is a 0, DTR is off.

LSR – Line Status Register

(Addr = 5)

This 8-bit register provides status information to the host concerning data transfer

Bit 7 **RX FIFO Error**
In the 16450 mode, this bit is not used and is always 0.
In the FIFO mode, this bit is set if there are one or more characters in the RX FIFO with parity error, framing error, or break indication detected. This bit is reset to a 0 when the host reads the LSR and note of the above conditions exist in the RX FIFO.

Bit 6 **Transmitter Empty (TEMT)**
This bit is set to a 1 whenever the TX Buffer (THR) and equivalent of the Transmitter Shift Register (TRS) are both empty. It is reset to a 0 whenever either the THR or the equivalent of the TSR contains a character.
In the FIFO mode, this bit is set to a 1 whenever the TX FIFO and the equivalent of the TSR are both empty

Bit 5 **Transmitter Holding Register Empty (THRE) [TX Buffer Empty]**
This bit, when set, indicates that the TX Buffer is empty and the modem can accept a new character for transmission. In addition, this bit causes the modem to issue an interrupt to the host when the Transmit Holding Register Empty Interrupt Enable bit (IIR1) is set to 1. The THRE bit is set to a 1 when a character is transferred from the TX Buffer. The bit is reset to 0 when a byte is written into the TX Buffer by the host.
In the FIFO mode, this bit is set when the TX FIFO is empty; it is cleared when at lease one byte is in the TX FIFO.

Bit 4 **Break Interrupt (BI)**
This bit is set to a 1 whenever the received data input is a space (logic 0) for longer than two full word lengths plus 3 bits. The BI is reset when the host reads the LSR.

Bit 3 **Framing Error (FE)**
This bit indicates that the received character did not have a valid stop bit. The FE bit is set to a 1 whenever the stop bit following the last data bit or parity bit is detected as a logic o (space). The FE bit is reset to a 0 when the host reads the LSR.
In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The FE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 2 **Parity Error (PE)**
This bit indicates that the received data character in the RX Buffer does not have the correct even or odd parity, as selected by the Even Parity Select bit (LCR4) and the Stick Parity bit (LCR5). The PE bit is reset to a 0 when the host reads the LSR.
In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The PE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 1 **Overrun Error (OE)**
This bit is set to a 1 whenever received data is loaded into the RX Buffer before the host has read the previous data from the RX Buffer. The OE is reset to a 0 when the host reads the LSR.
In the FIFO mode, if data continues to fill beyond the trigger level, an overrun condition will occur only if the RX FIFO is full and the next character has been completely received.

Bit 0 **Receiver Data Ready (DR)**
This bit is set to a 1 whenever a complete incoming character has been received and transferred into the RX Buffer. The DR bit is reset to a 0 when the host reads the RX Buffer.
In the FIFO mode, the DR bit is set when the number of received data bytes in the RX FIFO equals or exceeds the trigger level specified in the FCR0-FCR1.

MSR – Modem Status Register

(Addr = 6)

The Modem Status Register (MSR) reports current state and change information of the modem. Bits 4-7 supply current state and bits 0-3 supply change information. The change bits are set to a 1 whenever a control input form the modem changes state from the last MSR read by the host. Bits 0-3 are reset to 0 when the host reads the MSR or upon reset.

Whenever bits 0, 1, 2, or 3 are set to a 1, a Modem Status Interrupt (IIR0-IIR3 = 0) is generated.

Bit 7 **Data Carrier Detect (DCD)**
This bit indicates the logic state of the DCH# (RLSD#) output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out2 bit in the MCR (MCR3).

Bit 6 **Ring Indicator (RI)**
This bit indicates the logic state of the RI# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out1 bit in the MCR (MCR2).

Bit 5 **Data Set Ready (DSR)**
This bit indicates the logic state of the DSR# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the DTR in the MCR (MCR0).

Bit 4 **Clear to Send (CTS)**
This bit indicates the logic state of the CTS# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the RTS bit in the MCR (MCR1).

Bit 3 **Delta Data Carrier Detect (DDCD)**
This bit is set to a 1 when the DCD bit changes state since the host last read the MSR.

Bit 2 **Trailing Edge of Ring Indicator (TERI)**
This bit is set to a 1 when the RI bit changes from a 1 to a 0 state since the host last read the MSR.

Bit 1 **Delta Data Set Ready (DDSR)**
This bit is set to a 1 when the DSR bit has changed since the host last read the MSR.

Bit 0 **Delta Clear to Send (DCTS)**
This bit is set to a 1 when the CTS bit has changed since the MSR the host last read the MSR.

RBX – RX Buffer (Receiver Buffer Register)

(Addr = 0, DLAB = 0)

The RX Buffer (RBR) is a read-only register at location 0 (with DLAB = 0). Bit 0 is the least significant bit of the data and is the first bit received.

THR – TX Buffer (Transmitter Holding Register)

(Addr = 0, DLAB = 0)

The TX Buffer (THR) is a write-only register at address 0 when DLAB = 0. Bit 0 is the least significant bit and the first bit sent.

SCR – Scratch Register

(Addr = 7)

The Scratchpad Register is a read-write register at location 7. This register is not used by the modem and can be used by the host for temporary storage.

Divisor Registers

(Addr = 0 and 1, DLAB = 1)

The Divisor Latch LS (least significant byte) and Divisor Latch MS (most significant byte) are two read-write registers at locations 0 and 1 when DLAB = 1, respectively.

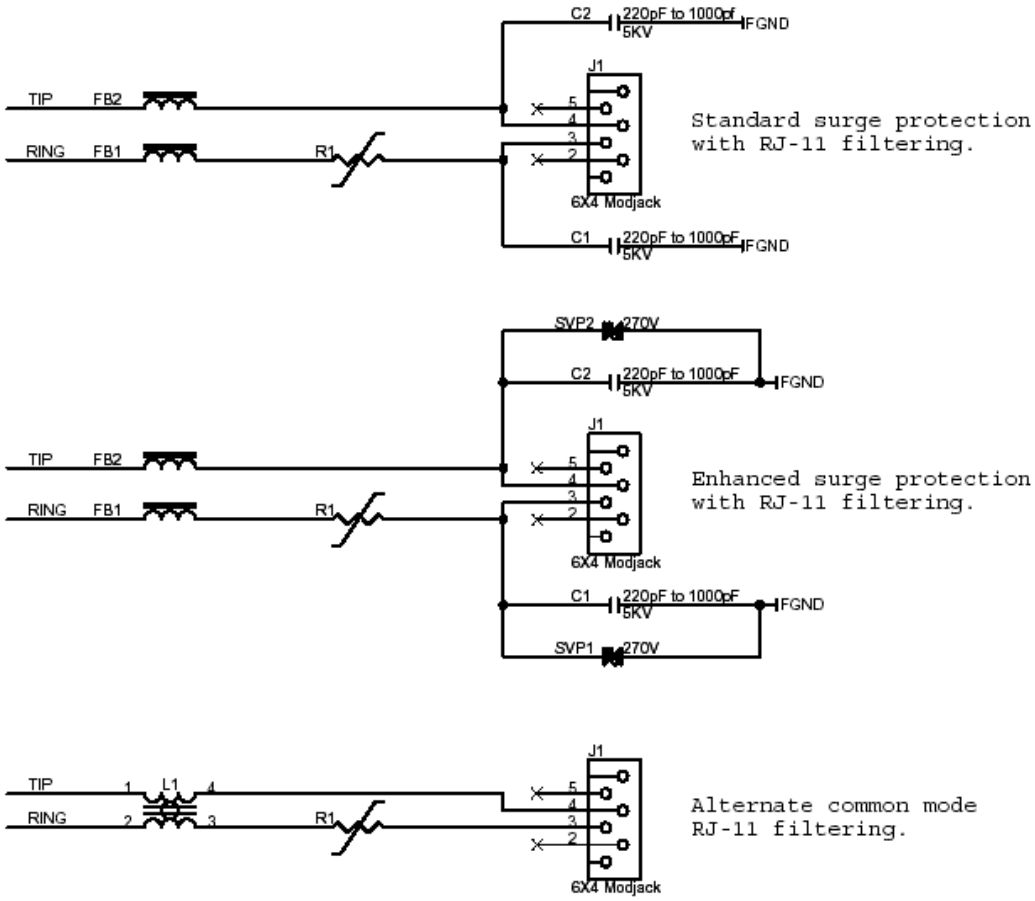
The baud rate is selected by loading each divisor latch with the appropriate hex value. Programmable values corresponding to the desired baud rate are listed in Table on following page.

Divisor Latch (Hex)		Divisor (Decimal)	Baud Rate
MS	LS		
06	00	1536	75
04	17	1047	110
03	00	768	150
01	80	384	300
00	C0	192	600
00	60	96	1200
00	30	48	2400
00	18	24	4800
00	0C	12	9600
00	06	6	19200
00	04	4	28800
00	03	3	38400
00	02	2	57600
00	01	1	115600
00	00	NA	230400

Programmable Baud Rates

Application Notes

Tip and Ring Interface



OEM Motherboard

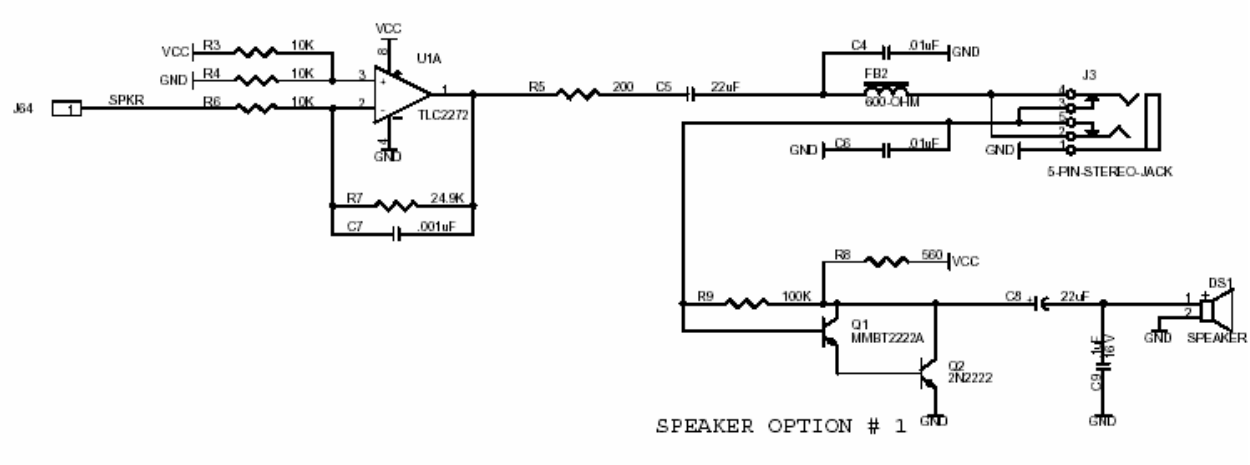
Filtering and Surge Protection Options

See *Design Considerations* and *Recommended Parts* in Chapter 1.

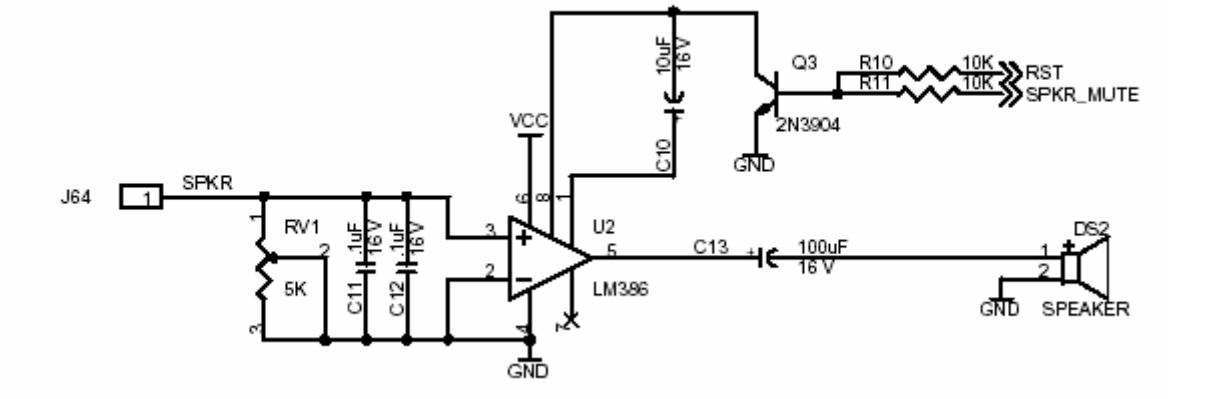
Microphone and Speaker

Note: Applies to the MT5656SMI only.

Microphone Input Option



Speaker Output Option 1



Speaker Output Option 2

Chapter 3

SocketModem®

MT5634SMI
MT9234SMI

Chapter 3 – SocketModem (MT5634SMI & MT9234SMI)

Introduction

Multi-Tech's SocketModem creates communication-ready devices by integrating data/fax/voice functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92/56K communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

The MT5634SMI and the MT9234SMI SocketModems are used for integrating data and fax communications. They are single-port modems that integrate the controller, DSP, and DAA in a 1" x 2.5" form factor and communicate to a host controller via an asynchronous serial interface

Notes:

- The MT9234SMI is a newer modem that will, in the near future, be replacing the MT5634SMI. The functionality of this MT9234SMI will be the same as the MT5634SMI.
- MT9234SMI is recommended for new designs.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT9234SMI			
MT9234SMI-34	V.34 Serial Data, V.34 Fax, 5V	Global	
MT9234SMI-92	V.92 Serial Data, V.34 Fax, 5V	Global	
MT9234SMI-P-92	V.92 Parallel Data, V.34 Fax, 5V	Global	
MT9234SMI-ITP-92	V.92 Serial Data, V.34 Fax, Industrial Temperature, 5V	Global	
MT9234SMI-P-ITP-92	V.92 Parallel Data, V.34 Fax, Industrial Temperature, 5V	Global	
MT9234SMI-HV-92	V.92 Serial Data, V.34 Fax, High Voltage, 5V	Global	
MT9234SMI-P-HV-92	V.92 Parallel Data, V.34 Fax, High Voltage, 5V	Global	
MT5634SMI			
MT5634SMI-34.Rx	V.34 Serial Data, V.34 Fax, 5V	Global	
MT5634SMI-92.Rx	V.92 Serial Data, V.34 Fax, 5V	Global	
MT5634SMI-HV-92.Rx	V.92 Serial Data, V.34 Fax, High Voltage, 5V	Global	
MT5634SMI-ITP-92.Rx	V.92 Serial Data, V.34 Fax, Industrial Temperature, 3.3V	Global	
MT5634SMI-P-92.Rx	V.92 Parallel Data, V.34 Fax, 5V	Global	
MT5634SMI-P-HV-92.Rx	V.92 Parallel Data, V.34 Fax, High Voltage, 5V	Global	
MT5634SMI-P-ITP-92.Rx	V.92 Parallel Data, V.34 Fax, Industrial Temperature, 3.3V	Global	
Telecom Label			
MT5634SMI-LS	MT5634SMI – Global Regulatory Label	Global	
MT9234SMI-LS	MT9234SMI – Global Regulatory Label	Global	
Developer Kits			
MTSMI-UDK	Universal Developer Kit	Global	
MTSMI-P-UDK	SocketModem Parallel Developer Kit	Global	

How to Read the Product Codes in the Table Above:

34	V.34/33.6K data rate
92	V.92/56K data rate
HV	High Voltage 2KV Dielectric Isolation (EN60601)
ITP	Industrial Temperature Build
P	Parallel interface (serial is default)
LS	Telecom Label
UDK	Universal Developer Kit

Other Product Codes:

Rx "R" indicates product revision. "*x*" is the revision number.

Technical Specifications for MT5634SMI and MT9234SMI

The SocketModems (MT5634SMI and MT9234SMI) meet the following specifications:

Category	*Description*
Data Standards	V.92, V.34 enhanced, V.34, V.32bis, V.32, V.22bis, V.22; Bell 212A and Bell 103
Data Format	Serial,or 8-bit parallel interface, asynchronous
Character Format	10 bit or 11 bit
Serial/Data Speeds	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps
Client-to-Client Data Rates	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400, 1200, 0-300 bps
Data Error Correction (ECM)	V.44; V.42 (LAPM, MNP 2-4)
Data Compression	V.42bis, MNP 5
Fax Compatibility	V.17, V.29/V.27/V.21, V.34
Fax Class	Class 1 &1.0 – All builds Class 2, 2.0/2.1 – All builds except MT5634SMI-34
Fax Compression	MH, MR, MMR
Fax Error Correction Mode	EMC
Modes of Operation	Fax online modes; full duplex over dial-up lines; data mode; command mode; online command mode; V.54 test mode
Dimensions	2.541” L × 1.045” W × 0.68” H (6.45cm x 2.65cm x 1.7cm)
Weight	0.6 oz. (0.017 kg.)
OperatingTemperature	0° to +70° C -40° to +85° C (Industrial Temperature build option)
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	**3.3V** 3.3VDC, 180mA Absolute Maximum Supply Voltage: 3.6VDC **5V** 5VDC ± 5% Absolute Maximum Supply Voltage: 5.5VDC
Power Requirements	**MT5634SMI** **3.3V** Typical: 180mA (0.59W @ 3.3VDC) Maximum: 290mA (1.04W @ 3.6VDC) **5V** Typical: 260mA (1.3W @ 5VDC) Maximum: 420mA (2.1W @ 5.25VDC) **MT9234SMI** **3.3V** Typical: 122mA (0.40W @ 3.3VDC) Maximum: 136mA (.49W @ 3.6VDC) **5V** Typical: 125mA (.62W @ 5VDC) Maximum: 138mA (.72W @ 5.25VDC)
Transmit Level	- 11 dBm (varies by country setting)
Receiver Sensitivity	- 43 dBm under worst-case conditions
DAA Isolation	**MT5634SMI-92 and MT9234SMI** 1.5Kv r.m.s. or 2121 VDC at working voltage of 250VAC **MT5634SMI-HV-92 and MT9234SMI** 2Kv r.m.s. or 2828VDC at working voltage of 125VAC
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	60 characters
Telephony / TAM	TAM: S-101 AT+V commands (no CODEC for speakers/microphone interface)

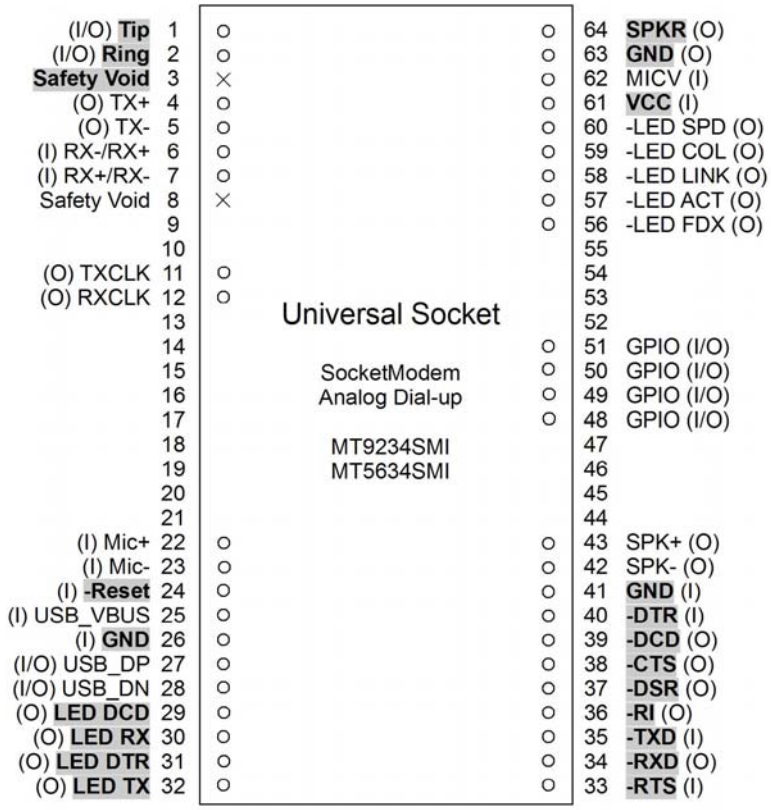
Category	*Description*
Certifications & Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 CCC **Safety Certifications for HV Builds** UL 60601-1 EN 60601-1 **EMC Approvals** FCC Part 15 Canadian EMC EN 55022 EN 55024 GB4943, GB9254
Warranty	2 years
Intelligent Features	Fully AT command compatible Leased-line operation Sleep mode Autodial, redial Pulse or tone dial Dial pauses Auto answer Adaptive line probing Automatic symbol and carrier frequency during start-up, retrain, and rate renegotiations DTMF detection Callback security Distinctive ring Voice record and playback Call status display, auto-parity and data rate selections Keyboard-controlled modem options On-screen displays for modem option parameters Remote configuration DTR dialing Phone number storage Flash memory for firmware updates NVRAM storage for user-defined parameters

SocketModem Configuration

Serial Configuration

The MT5634SMI/MT9234SMI SocketModem uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, LED driver for call status annunciation, and serial interface.

Note: The **bolded, shaded pins** are the **active** MT5634SMI/MT9234SMI pins.



Top View

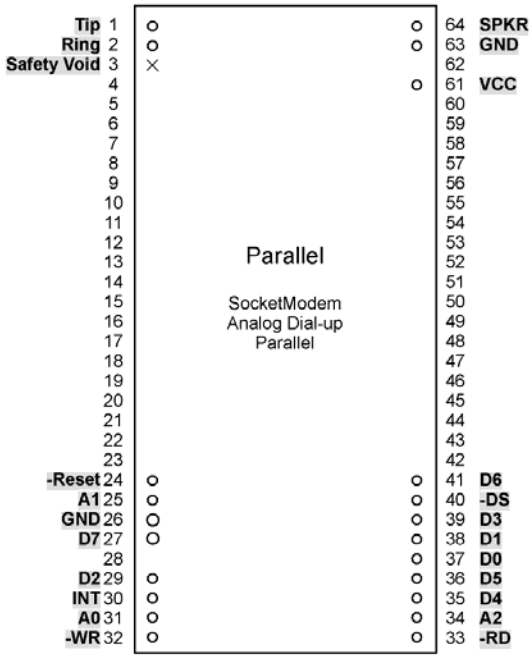
Serial SocketModem Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Parallel Configuration

The parallel configuration is not compatible with the serial universal socket.
The Parallel SocketModem uses a 22-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, and parallel interface.

Note: The **bolded, shaded pins** are the **active** MT5634SMI-P / MT9234SMI-P (Parallel) pins.



Top View

Parallel SocketModem Pins

Pin Descriptions for a Parallel SocketModem Device

Pin #	Signal	I/O	Description
1	Tip	I/O	**Telephone Line Interface – TIP**
2	Ring	I/O	**Telephone Line Interface – RING**
24	–RESET	I	**Modem Reset (with pull-up).** Active low –RESET input resets the SocketModem logic and returns AT command set to original factory defaults or to NVRAM 'stored values' . The modem is ready to accept commands within 6.5 seconds of power-on or reset. Reset must be asserted for a minimum of 30ms.
25	A1	I	**Host Bus Address Line 1**
26	DGND	GND	**Digital Ground**
27	D7	O	**Host Bus Data Line 7**
29	D2	O	**Host Bus Data Line 2**
30	INT	O	**Host Bus Interrupt Line.** INT output is set high when the receiver error flag, receiver data available, transmitter holding register empty, or modem status interrupt have an active high condition. INT is reset low upon the appropriate interrupt service or master reset operation.
31	A0	I	**Host Bus Address Line 0.**
32	–WR	I	**Host Bus Write.** –WR is an active low, write control input. When –DS is low, –WR low allows the host to write data or control words into a selected modem register.
33	–RD	I	**Host Bus Read.** –RD is an active low, read control input. When –DS is low, –RD low allows the host to read status information or data from a selected modem register.
34	A2	I	**Host Bus Address Line 2**
35	D4	O	**Host Bus Data Line 4**
36	D5	O	**Host Bus Data Line 5**
37	D0	O	**Host Bus Data Line 0**
38	D1	O	**Host Bus Data Line 1**
39	D3	O	**Host Bus Data Line 3**
40	–DS	I	**Host Bus Device Select.** –DS input low enables the modem for read or write.
41	D6	O	**Host Bus Data Line 6**
61	VCC	PWR	**+5 V or 3.3 V Supply** (depends upon model).
63	AGND	GND	**Analog Ground.** This is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker Output**. SPKR is a single ended-output. It is tied to the CODEC through a series 6.8K resistor and .1uf cap.

Electrical Characteristics

3.3V Serial – Industrial Temperature (SMI-ITP) Build Option

3.3VDC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 2.52V	**Input Low** Max 0.9V	
–**Reset** (24)	**Input High** Min 2.52V	**Input Low** Max 0.3V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

3.3V Parallel – Industrial Temperature (SMI-ITP) Build Options

3.3VDC Characteristics (TA = –40 °C to 85 °C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DS (40)	**Input High** Min 2.52V	**Input Low** Max 0.9V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	**Input High** Min 2.52V	**Input Low** Max 0.9V	
Digital Input/Output **Output buffer can source 12 mA at 0.4 V** DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	**Input High** Min 2.52V	**Input Low** Max 0.9V	
Digital Output INT (30)	**Output High** Min 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

5V Serial – Standard (SMI) and Medical Device (SMI-HV) Build Options

5VDC Characteristics (TA = 0 °C to 50 °C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 3.675V	**Input Low** Max 1.4V	
–**Reset** (24)	**Input High** Min 3.675V	**Input Low** Max 0.3V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 4V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

5V Parallel – Standard (SMI) and Medical Device (SMI-HV) Build Options

5VDC Characteristics (TA = 0 °C to 50 °C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Digital Inputs –DS (40)	**Input High** Min. 3.675V	**Input Low** Max. 1.4V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	**Input High** Min. 3.675V	**Input Low** Max. 1.4V	
Digital Input / Output **Output buffer can source 12 mA at 0.4 V** DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	**Input High** Min. 3.675V	**Input Low** Max. 1.4V	
Digital Output INT (30)	**Output High** Min. 4V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

Parallel Timing Requirements

Timing Requirements for Parallel Write

Parameter	Min	Max	Unit
–DS to –WR Setup (low to low)	10	-	ns
A0, A1, A2 to –WR Setup (valid to low)	15	-	ns
–WR Pulse Width (low to high)	40	-	ns
D0–D7 to –WR Setup (valid to high)	30	-	ns
–WR to –DS hold (high to high)	0	-	ns
–WR to A0–A2 Hold (high to invalid)	0	-	ns
–WR to D0–D7 Hold (high to invalid)	0	-	ns
–WR interaccess (high to low) Non-MIMIC Accesses MIMIC Accesses	 10 110	 - -	 ns ns

Timing Requirements for Parallel Read

Parameter	Min	Max	Unit
–DS to –RD Setup (low to low)	10	-	ns
A0, A1, A2 to –RD Setup (valid to low)	15	-	ns
–RD Pulse Width (low to high)	40	-	ns
–RD to –DS hold (high to high)	0	-	ns
–RD to A0–A2 Hold (high to invalid)	0	-	ns
–WR interaccess (high to low) Non-MIMIC Accesses MIMIC Accesses	 10 110	 - -	 ns ns

SocketModem Parallel Interface Internal Registers

The SocketModem parallel interface is a mimic of a 16C550A UART. It is similar to the MIMIC interface used in the Zilog Z80189. The SocketModem mimic (MMM) takes advantage of this standard interface while replacing the serial to parallel data transfer with a less complicated parallel to parallel data transfer.

The MMM interface controls an 8-bit parallel data transfer which is typically interrupt driven. Interrupts usually indicate one or both of two conditions: (1) the receive (RX) FIFO has either reached a trigger level or time-out condition and needs to be emptied and/or (2) the transmit (TX) FIFO is empty and waiting for more data from the Host. An interrupt can also be triggered by a change in the modem status register (i.e., loss of carrier) or by the occurrence of errors in the line status register (overrun, parity, framing, break detect).

In addition to the receive and transmit FIFOs, there are twelve other control/status registers called the MMM register set which can be accessed through this interface.

Overview

SocketModem MIMIC (MMM) Operation

Data flow through MMM is bi-directional. Simultaneously, data can flow from the host through the transmit FIFO to the SocketModem controller, and data can flow from SocketModem controller through the receive FIFO to the Host. In the receive path, 8-bit data is asynchronously received (from the SocketModem controller) by the receive FIFO where it is stored along with associated three error bits. The error bits must arrive (via a SocketModem controller I/O write to MMM shadow line status register) prior to receiving the actual data bits. The error bits are then temporarily stored so they may be written, with associated data bits, to the 11-bit wide RX FIFO.

After every data write, the RX FIFO write pointer is incremented. RX FIFO trigger levels, data ready signal, and time-out counter are checked to see if a Host interrupt needs to be sent. The data ready signal will be activated and MMM sits poised to accept another data word.

We highly recommend the host should read the MMM IIR register to determine the type of interrupt. Then it might check bit 7 of the LSR to see if there are any errors in the data currently residing in the receive FIFO. Finally, it will (1) alternately read a data word through the RX FIFO read pointer and the error bits via the MMM LSR until the FIFO is empty, or (2) read successive data words (knowing there were no errors in the FIFO) until the trigger count is met.

A similar sequence occurs when data flows in the other direction (from host through transmit FIFO), except there is no error bit manipulation/checking involved.

FIFO Operation

The 16-byte transmit and receive data FIFOs are enabled by the FIFO Control Register (FCR) bit-0. You can set the receive trigger level via FCR bits 6/7. The receiver FIFO section includes a time-out function to ensure data is delivered to the external host. An interrupt is generated whenever the Receive Holding Register (RHR) has not been read following the loading of a character or the receive trigger level has been reached.

Receive (RX) FIFO

The RX FIFO can be configured to be 16 words deep and 11 bits wide. Each word in the RX FIFO consists of 8 data bits and 3 error bits. The RX block of the MMM contains read and write pointers and status flag circuitry that need only to be presented with data (for input), reset, read/write control signals, and read/write clock signals. The RX block of the MMM internally manages the FIFO register file and pointers, and it provides simultaneous read/write capability (no contention problems).

The RX block of the MMM provides data (for output), FIFO full flag, FIFO empty flag, and an almost full flag which uses an associated predefined trigger level (obtained from the MMM FCR control register) to signal when the trigger level has been met. Four possible trigger levels may be selected by programming bits 6-7 of the FCR control register.

A typical (interrupt driven) write to the RX block is a two-step process. The MMM micro-controller must first write the 3 error bits to a shadow MMM LSR status register. Next, the micro-controller writes the data to the RX FIFO and during this write operation, the 3 error bits are directly loaded from the LSR shadow register into the bits 8-10 of the selected (11 bit-wide) FIFO register. These error bits represent the parity error, framing error, and break interrupt signals associated with each data work transmission into the receive FIFO. When the receive FIFO is read, these error bits are loaded directly into bits 2-4 of the MMM LSR register.

A2	A1	A0	Register Name	Register Description	Host Access
0	0	0	RBR	Receive Buffer (RX FIFO)	DLAB = 0 R only
0	0	0	THR	Transmit Holding (TX FIFO)	DLAB = 0 W only
0	0	1	IER	Interrupt Enable	DLAB = 0 R/W
0	1	0	IIR	Interrupt Identification	DLAB = X R only
0	1	0	FCR	FIFO Control	DLAB = X W only
0	1	1	LCR	Line Control	DLAB = X R/W
1	0	0	MCR	Modem Control	DLAB = 0 R/W
1	0	1	LSR	Line Status	DLAB = X R only
1	1	0	MSR	Modem Status	DLAB = X R only
1	1	1	SCR	Scratch pad	DLAB = 0 R/W
0	0	0	DLL	LSB of Divisor Latch	DLAB = 1 R/W
0	0	1	DLM	MSB of Divisor Latch	DLAB = 1 R/W
1	1	1	DLX	Divisor Latch	DLAB = 1 R/W
1	0	0	MCX	Status/Control	DLAB = 1 R/W

Note 1* The General Register set is accessible only when DS is a logic 0.

Note 2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.

Time Out Interrupts

The interrupts are enabled by IER bits 0-3. Care must be taken when handling these interrupts. Following a reset the transmitter interrupt is enabled, the SocketModem will issue an interrupt to indicate that transmit holding register is empty. This interrupt must be serviced prior to continuing operations.

The LSR register provides the current singular highest priority interrupt only. A condition can exist where a higher priority interrupt may mask the lower priority interrupt(s). Only after servicing the higher pending interrupt will the lower priority interrupt(s) be reflected in the status register. Servicing the interrupt without investigating further interrupt conditions can result in data errors. When two interrupt conditions have the same priority, it is important to service these interrupts correctly.

Receive Data Ready and Receive Time Out have the same interrupt priority (when enabled by IER bit-3). The receiver issues an interrupt after the number of characters received have reached the programmed trigger level. In this case the MMM FIFO may hold more characters than the programmed trigger level. Following the removal of a data byte, the user should recheck LSR bit-0 for additional characters. A Receive Time Out will not occur if the receive FIFO is empty. The time out counter is reset at the center of each stop bit received or each time the receive holding register (RHR) is read.

Register Functional Definitions

The following table delineates the assigned bit functions for the twelve internal registers. The assigned bit functions are more fully defined in the following paragraphs.

Internal Registers

A2 A1 A0	Register [Default] *3	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0
General Register Set: Note 1*									
0 0 0	RBR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 0	THR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	IER [00]	0	0	0	0	Modem Status Interrupt	Receive Line Status interrupt	Transmit Holding Register interrupt	Receive Holding Register interrupt
0 1 0	IIR [XX]	FIFO enable	FIFO enable	0	0	Interrupt ID	Interrupt ID	Interrupt ID	Interrupt Pending
0 1 0	FCR [00]	RX Trigger (MSB)	RX trigger (LSB)	Detect change in FCR	TX FIFO overrun bit	DMA mode select	XMIT FIFO reset	RCVR FIFO reset	FIFO enable
0 1 1	LCR [00]	Divisor latch access (DLAB)	Set break	Stick parity	Even parity	Parity enable	0	Word length bit-1	Word length bit-0
1 0 0	MCR [00]	0	0	0	Loop back	INT enable	OUT 1	-RTS	-DTR
1 0 1	LSR [60]	RX FIFO data error	TX empty THR empty	THR Empty	Break interrupt	Framing error	Parity error	Overrun error	Receive data ready
1 1 0	MSR [X0]	CD	RI	DSR	CTS	Delta -CD	Delta -RI	Delta -DSR	Delta -CTS
1 1 1	SCR [FF]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
Special Register Set: Note *2									
0 0 0	DLL [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	DLM [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0

Note: 1* The General Register set is accessible only when DS is a logic 0.
2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.
3* The value between the square brackets represents the register's initialized HEX value, X = N/A.

RBR – Receive Buffer (RX FIFO)

All eight bits are used for receive channel data (host read/data in; host write/data out). The three error bits per byte are copied into bits 2, 3, and 4 of the LSR during each host I/O read; therefore, they are available for monitoring on a per-byte basis.

THR – Transmit Holding Register (TX FIFO)

All eight bits are used for transmit channel data (host write/data out; host read/data in).

IER – Interrupt Enable

Bits 4–7: Reserved and will always read 0.

Bits 0-3: Set by host software only and cleared by software control or host reset.

Bit 3: Enables modem status IRQ. If bits 0–3 of the MSR are set and this bit is set to 1 (enabled), a host interrupt is generated.

Bit 2: Enables receive line status IRQ. If bits 1–4 (overrun, parity, framing, break errors) of the LSR are set and this bit is set to a logic 1, a host interrupt is generated.

Bit 1: Enables transmit holding register IRQ. If bit 5 (transmit holding register empty) of the LSR is set and this bit is set to a 1, a host interrupt is generated.

Bit 0: Enables received data available IRQ. If bit 0 (data ready) of the LSR is set and this bit is set to a 1, a host interrupt is generated.

IIR – Interrupt Identification (Read Only)

Bits 6–7: (FIFO enabled bits). These bits will read a 1 if FIFO mode is enabled and the 16450 enable bit is 0 (no force of 16450 mode).

Bits 4–5: Reserved and always read a 0.

Bits 1–3: Interrupt ID bits.

Bit 0: Interrupt pending. If logic 0 (in default mode), an interrupt is pending.

When the host accesses IIR, the contents of the register are frozen. Any new interrupts will be recorded, but not acknowledged during the IIR access. This requires buffering bits (0–3, 6–7) during IIR reads.

Interrupt Sources and Reset Control Table

Bit 3	Bit 2	Bit 1	Priority	Interrupt Source	Interrupt Reset Control
0	1	1	Highest	Overrun, parity, framing, error or break detect bits set by SocketModem Controller	Reading the LSR
0	1	0	2nd	Received data trigger level	RX FIFO drops below trigger level
1	1	0	2nd	Receiver time-out with data in RX FIFO	Read RX FIFO
0	0	1	3rd	TX holding register empty	Writing to TX holding register or reading IIR when TX holding register is source of error
0	0	0	4th	MODEM status: CTS, DSR, RI or DCD	Reading the MSR

FCR – FIFO Control

Bits 6–7: Used to determine RX FIFO trigger levels.

Bit 5: Used to detect a change in the FCR.

Bit 4: TX FIFO overrun bit.

Bit 3: DMA mode select. If bit 3 is a 0, the 16450 mode is enabled which does only single-byte transfers. When bit 3 is a 1, it enables a multiple byte (FIFO mode) data transfer.

Bit 2: TX FIFO reset. This will cause TX FIFO pointer logic to be reset (any data in TX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.

Bit 1: RX FIFO reset. This will cause RX FIFO pointer logic to be reset (any data in RX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.

Bit 0: FIFO enable. The host writes this bit to logic 1 to put the block in FIFO mode. This bit must be a 1 when writing other bits in this register or they will not be programmed. When this bit changes state, any data in the FIFOs or the RBR and THR registers will be lost and any pending interrupts are cleared.

Bit 7	Bit 6	16 Deep FIFO Trigger Levels (# of bytes) Default
0	0	1
0	1	4
1	0	8
1	1	14

LCR – Line Control

Bit 7: Divisor latch access bit. This bit allows the host, access to the divisor latch. Under normal circumstances, the bit is set to 0 (provides access to the RX and TX FIFOs at address 0). If the bit is set to 1, access to transmitter, receiver, interrupt enable, and modem control registers is disabled. In this case, when an access is made to address 0, the divisor latch least (DLL) significant byte is accessed. Address 1 accesses the most significant byte (DLM). Address 7 accesses the DLX divisor latch register. Address 4 accesses the MCX status/control register.

Bit 6: Used to denote a host-generated set break condition.

Bits 0,1,3,4,5: Used only in parity bit generation for the 7 bit data byte case. Bits 0 and 1 are used for word length select (b0 = 0 and b1 = 1 is used for 7 bit data). Bit 3 is parity enable. Bit 4 is even parity select. Bit 5 is stick parity.

MCR – Modem Control

Bits 5–7: Reserved, and will always be 0.

Bit 4: Used for loopback. When a 1, bits 0–3 of the MCR are reflected in modem status register (MSR) as follows: RI <= OUT1, DCD <= OUT2, DSR <= DTR, CTS <= RTS. Emulation of loopback feature of 16550 UART must be done by the host except for the above conditions. Also, when this bit is set, it allows for data loop back. This means the host can write a data word to the TX and immediately read back the same data word from the RX (in a manner similar to the 16550A).

Bit 3: Controls the signal used to 3-state the host interrupt. If 0, then an active-low L33xV output will be set to 0, and this signal will be used to 3-state the host interrupt output pin.

Bits 0–2: Used during LOOP function.

Bit 2: OUT1.

Bit 1: Request to Send (RTS).

Bit 0: Data terminal ready (DTR).

LSR – Line Status

Bit 7: Error in RX FIFO. This bit is always set to 1 if at least one data byte in the RX FIFO has an error. This will clear when there are no more errors in the RX FIFO.

Bit 6: Transmitter empty. This bit is the same as LSR bit 5 (THRE) in MMM

Bit 5: Transmitter holding register empty. This bit is set to 1 when either the transmitter holding register has been read (emptied) by the micro-controller (16450 mode) or the TX FIFO is empty (16550 mode). This bit is set to 0 when either the THR or the TX FIFO becomes not empty in 16450 mode. In 16550 mode, it is set to 0 only after the trigger level has been met since the last occurrence of TX FIFO empty. If the transmitter timer is enabled, a shadow bit exists which delays the timer setting this bit to 1. When reading this bit, the micro-controller will not see the delay. Both shadow and register bits are cleared when the host writes to the THR or TX FIFO in 16450 mode. The trigger level must be reached to clear the bit in 16550 (FIFO) mode.

Bits 2–4: Used for parity error, framing error, and break detect. These bits are written, indirectly, by the micro-controller as follows: The bits are first written to the shadow bit locations when the micro-controller write accesses the LSR. When the next character is written to the receive buffer (RBR) or the RX FIFO, the data in the shadow bits is then copied to the RBR (16450 mode) or RX FIFO (16550 mode). In FIFO mode, bits become available to the host when the data byte associated with the bits is next to be read. In FIFO mode, with successive reads of the receiver, the status bits will be set if an error occurs on any byte. Once the micro-controller writes to the RBR or RX FIFO, the shadow bits are auto cleared. The register bits are updated with each host read.

Bit 1: Overrun error. This bit is set if the micro-controller makes a second write to RBR before the host reads data in the buffer (16450 mode) or with a full RX FIFO (16550 mode). No data will be transferred to the RX FIFO under these circumstances. This bit is reset when the host reads the LSR.

Bit 0: Data ready bit. This bit is set to 1 when received data is available, either in the RX FIFO (16550 mode) or the RBR (16450 mode). This bit is set immediately upon the micro-controller writing data to the RBR or FIFO if the receive timer is not enabled, but it is delayed by the timer interval if the receive timer is enabled. For micro-controller read access, a shadow bit exists so that the micro-controller does not see the delay that the host sees. Both bits are cleared to logic 0 immediately upon reading all data in either RBR or RX FIFO.

MSR – Modem Status

Bits 4 through 7 of the MSR can also take on the MCR bits 0 through 3 value when in MCR loop mode (i.e. when MCR b4 = 1). The transfer of bits in loop back has a null modem twist (i.e. MCR b0 goes to MSR b5 and MCR b1goes to MSR b4).

Bit 7: Data carrier detect (DCD) bit.

Bit 6: Ring indicator (RI) bit.

Bit 5: Data set ready (DSR) bit.

Bit 4: Clear to send (CTS) bit.

Bit 3: Delta data carrier detect pin. This bit is set to a 1 whenever the data carrier detect bit changes state. It is reset when the host reads the modem status register.

Bit 2: Trailing edge ring indicator bit. This bit is set to 1 on the falling edge of the ring indicator bit. It is reset when the host reads the modem status register.

Bit 1: Delta data set ready bit. This bit is set to 1 whenever the data set ready changes state. It is reset when the host reads the modem status register.

Bit 0: Delta clear to send bit. This bit is a one whenever the clear to send bit changes state. It is reset when the host reads the modem status register.

SCR – Scratch

The host programmer uses this register for temporary data storage.

DLL – Divisor Latch (LSByte)

This register contains low-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation since MMM does not require the generation of a real baud clock.

DLM – Divisor Latch (MSByte)

This register contains high-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation, since MMM does not require the generation of a real baud clock.

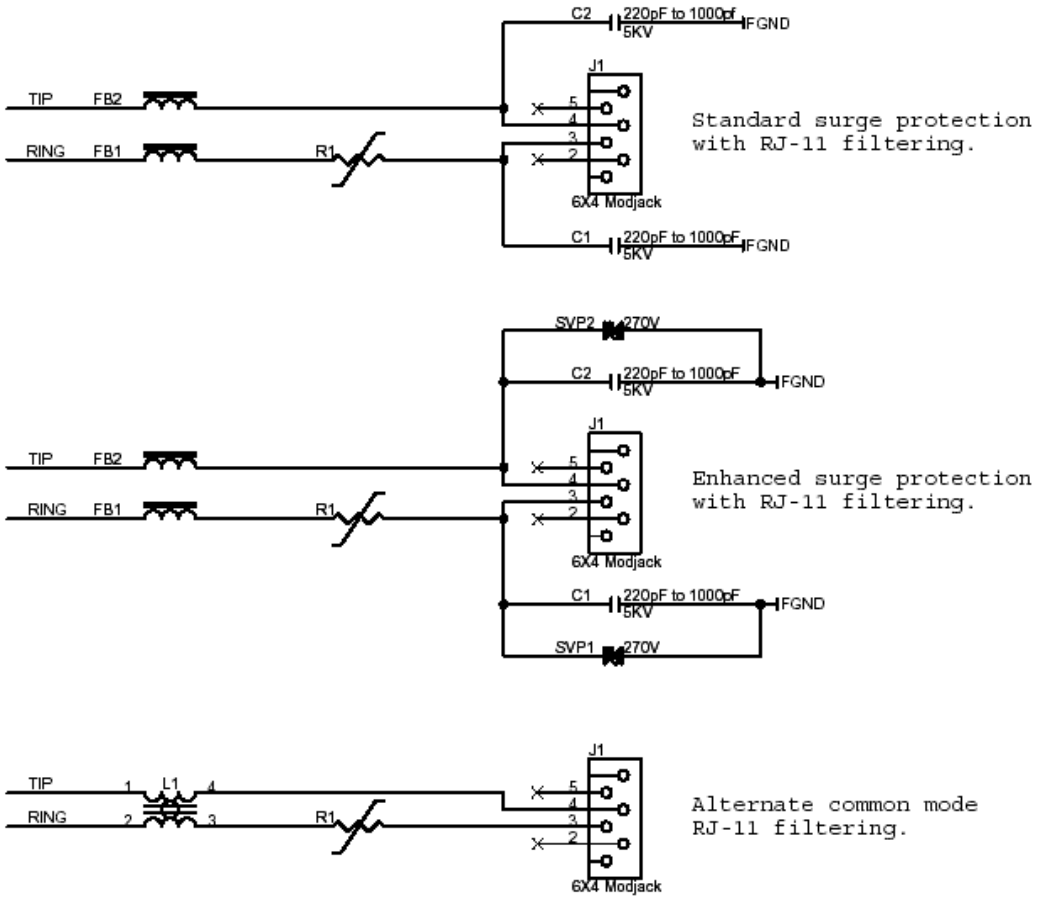
Programming the Baud Rate Generator Registers DLM (MSB) and DLL (LSB) provides a user capability for selecting the desired final baud rate. The example in the Table below shows the selectable baud rates available when using a 1.8432 MHz external clock input.

BAUD RATE GENERATOR PROGRAMMING TABLE

Baud Rate	16 x Clock Divisor (Decimal)	DLM Value (HEX)	DLL Value (HEX)
110	1047	04	17
300	384	01	80
600	192	00	C0
1200	96	00	60
2400	48	00	30
4800	24	00	18
9600	12	00	0C
19.2K	6	00	06
38.4K	3	00	03
57.6K	2	00	02
115.2K	1	00	01

Application Notes

Tip and Ring Interface



OEM Motherboard
Filtering and Surge Protection Options

See *Design Considerations and Recommended Parts* in Chapter 1.

Chapter 4

SocketModem®

MT2456SMI-22
MT2456SMI-L-22

Chapter 4 – SocketModem (MT2456SMI-22)

Introduction

The Multi-Tech SocketModem supports analog data modem operation with V.22bis Fast Connect, V.42bis data compression, and V.80 synchronous access mode. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that is ready-to-integrate into your applications; therefore, dramatically reducing development time and costs for system designers.

The MT2456SMI-22 SocketModem is a standard 20-pin modem used for integrating data communications. It is a single-port 5V or 3.3V modem that integrates a modem controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT2456SMI-22.Rx	V.22bis Serial Data 5V	Global	
MT2456SMI-L-22.Rx	V.22bis Serial Data 3.3V	Global	
Telecom Label			
MT2456SMI-LS	MT2456SMI-Global Regulatory Label	Global	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

22 V.22bis
L 3.3 Volt Build
LS Telecom Label
UDK Universal Developer Kit

Other Product Codes:

R*x* "R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketModem (MT2456SMI-22) meets the following specifications:

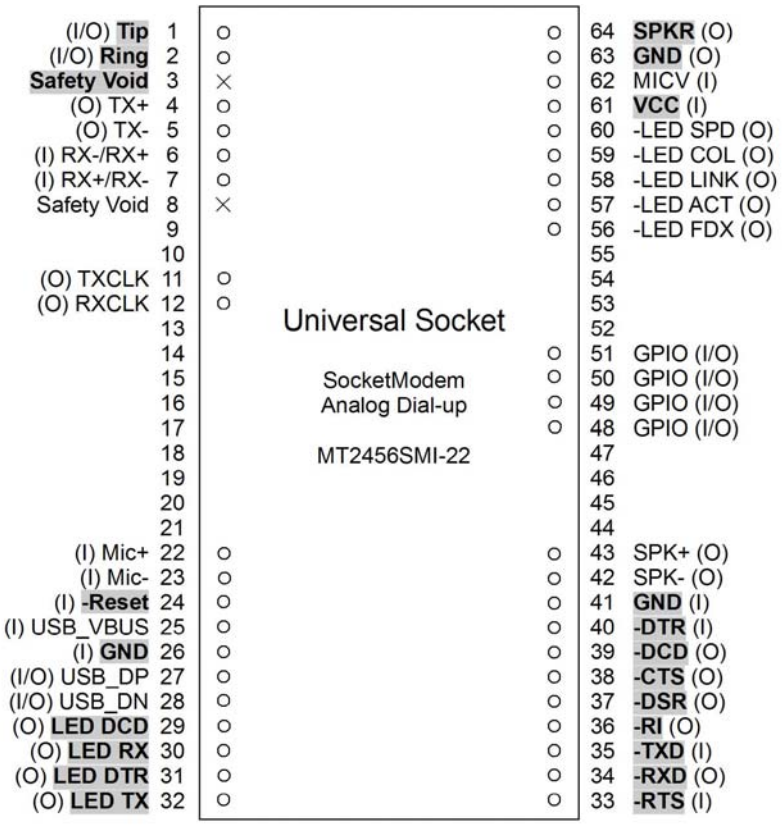
Category	*Description*
Data Standards	V.22bis, V.22; Bell 212A and 103
Data Format	Serial, asynchronous
Character Format	10 bit
Serial/Data Speeds	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, and 115,200
Client-to-Client Data Rates	2400, 1200, 0-300 bps
Data Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.42bis
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, and online command mode
Dimensions	2.541" L × 1.045" W × 0.68" H (6.45cm x 2.65cm x 1.7cm)
Weight	0.6 oz. (0.017 kg.)
Operating Temperature	0 to +70° C
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	Typical: 3.3 V DC ± 5%; Absolute Maximum Supply Voltage: 3.6 V DC Typical: 5 V DC ± 5%; Absolute Maximum Supply Voltage: 5.5 V DC
Power Consumption	**5 Volt:** Typical: 61mA (.305W @ 5VDC); Maximum: 68mA (.357W @ 5.25VDC) **3.3 Volt:** Typical: 62mA (.205W @ 3.3VDC); Maximum: 72mA (.259W @ 3.6VDC)
Transmit Sensitivity	-12 dBm (varies by country)
Receiver Sensitivity	-43 dBm
DAA Isolation	1.5Kv r.m.s. or 2121 VDC at working voltage of 250VAC
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	50 characters
Warranty	2 years
Intelligent Features	AT command compatible V.22bis fast connect Supports V.80 Supports Fast POS 9600 Line polarity reversal detection Line current loss detection Line-in-use detection Extension pickup detection Remote hang-up detection Call waiting detection U.S. Caller ID Autodial, redial Pulse or tone dial Auto answer Call status display

SocketModem Configuration

Serial Configuration

The **MT2456SMI-22** SocketModem with a serial interface uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: The **bolded, shaded pins** are **active** MT2456SMI-22 pins.



Top View

Serial SocketModem Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Electrical Characteristics

3.3V Serial SocketModem

3.3VDC Characteristics (TA = 0°C to 70°C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 2.0V	Max 0.8V	
Outputs	**Output High**	**Output Low**	
–DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2mA, Z_{INT} = 120 Ω	Min 2.4V	Max 0.4V	
Digital Input Capacitance			**50pF**

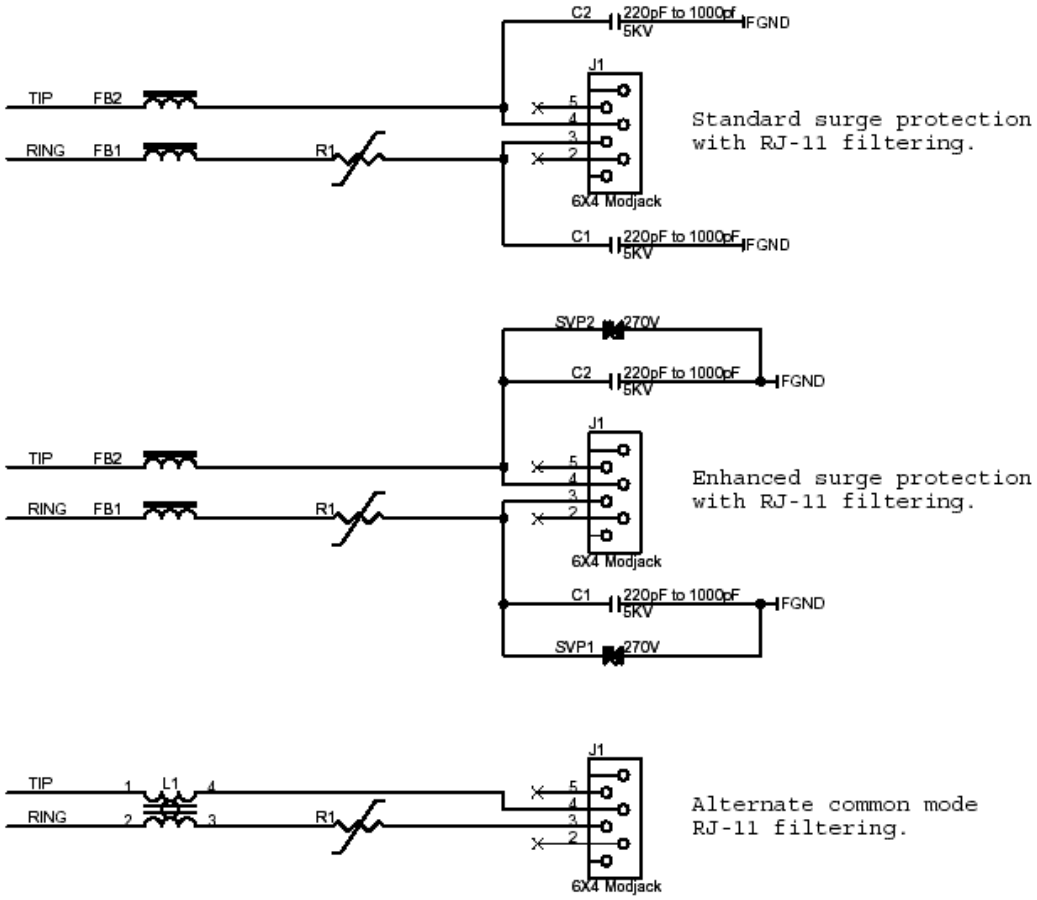
5V Serial SocketModem

5VDC Characteristics (TA = 0°C to 50°C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 2.0V	Max 0.8V	
Outputs	**Output High**	**Output Low**	
–DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2mA, Z_{INT} = 120 Ω	Min 2.4V	Max 0.4V	
Digital Input Capacitance			**50pF**

Applications Notes

Tip and Ring Interface



OEM Motherboard

Filtering and Surge Protection Options

See *Design Considerations* and *Recommended Parts* in Chapter 1.

Chapter 5

SocketModem® IP

MT2456SMI-IP-L-22
MT2456SMI-IP-L-32
MT2456SMI-IP-L-34
MT2456SMI-IP-L-92

Chapter 5 – SocketModem IP (MT2456SMI-IP)

Introduction

The SocketModem IP embedded modem creates Internet-ready devices by integrating modem functionality and a complete TCP/IP protocol stack into a single, universal socket design.

The space efficient (1" x 2.5"), ready-to-integrate embedded modem sends and receives data via e-mail, HTTP, or socket interfaces.

The SocketModem IP embedded modem brings Internet connectivity to any device without adding development time and costs. It also complies with telecom requirements globally allowing for worldwide shipments.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT2456SMI-IP-L-22.Rx	V.22bis/2400 baud SocketModem with IP – 3.3V	Global	
MT2456SMI-IP-L-32.Rx	V.32bis/14.4K SocketModem with IP – 3.3V	Global	
MT2456SMI-IP-L-34.Rx	V.34/33.6K SocketModem with IP – 3.3V	Global	
MT2456SMI-IP-L-92.Rx	V.92/56K SocketModem with IP – 3.3V	Global	
Telecom Label			
MT2456SMI-LS	MT2456SMI-Global Regulatory Label	Global	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

22	V.22bis/2400 baud
32	V.32bis/14.4K
34	V.34/33.6K
92	V.92/56K
IP	TCP/IP Protocol Stack
L	3.3 Volt
LS	Telecom Label
UDK	Universal Developer Kit

Other Product Codes:

R*x*	"R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SockeModem (MT2456SMI-IP) meets the following specifications:

Category	*Description*
Data Standards	V.92, V.34, V.32, V.32bis, V.22
Data Format	Serial, asynchronous
Character Format	10 bit
Serial/Data Speeds	Supports DTE speeds up to 230.4K bps
Client-to-Client Data Rates	33,600, 31,200, 28,800, 26,400, 24,000, 21,600, 19,200, 16,800 bps 14,400, 12,000, 9600, 7200, 4800 bps 2400, 1200, 0-300 bps
Data Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.44, V.42bis
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Dimensions	2.541" L x 1.045" W x 0.68" H (6.45cm x 2.65cm x 1.7cm)
Weight	0.6 oz. (0.017 kg.)
Operating Temperature	0° to +70° C ambient under closed conditions
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	Typical: 3.3VDC ± 10%; Absolute Maximum Supply Voltage: 3.6VDC
Power Consumption	**V.22bis**: Typical: 135mA (.445W @ 3.3VDC) Maximum: 195mA (.702W @ 3.6VDC) **V.92, V.34, V.32:** Typical: 165mA (.545W @ 3.3VDC) Maximum: 225mA (.780 W @ 3.47VDC)
Transmit Level	-12 dBm (varies by country)
Receiver Sensitivity	-43 dBm
DAA Isolation	1.5Kv r.m.s. or 2121 VDC at working voltage of 250VAC
Command Buffer	50 characters
Telephony/TAM	TAM (Telephone Answering Machine) In modem (transparent) mode V.253 commands: V.253 2-bit and 4-bit ADPCM, 8-bit linear PCM, and 4-bit IMA coding 8 kHz sample rate Concurrent DTMF, ring, and Caller ID detection
Certifications & Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 CCC **EMC Approvals** FCC Part 15 (Class B) Canadian (Class B) EN 55022 (Class B) EN 55024 GB4943, GB9254
Warranty	2 years

Category	*Description*
Intelligent Features	Command Line SPI for Internet configuration AT commands compatible in modem mode autodial, redial pulse or tone dial dial pauses auto answer adaptive line probing automatic symbol and carrier frequency during start-up, retrain, and rate renegotiations DTMF detection call status display auto-parity and data rate selections Speaker interface for user-supplied call progress monitoring Caller ID (US configuration only) Internet Protocols Supported: Dial-in PPP, DNS, FTP, HTTP, ICMP,IP, LCP, POP3, PPP, SMTP, SNMP, SNTP, TCP, Telnet and TFTP, UDP Socket Dial-in PPP using remote dial-up networking Authentication Protocols: CHAP, Dial-up Script, PAP Binary Base 64 encoding and MIME email formats Web Server supports 30K of HTML web pages HTTP version 1.0 and 1.1 support Modem mode bypasses the IP features Flash memory to update firmware with the latest enhancements

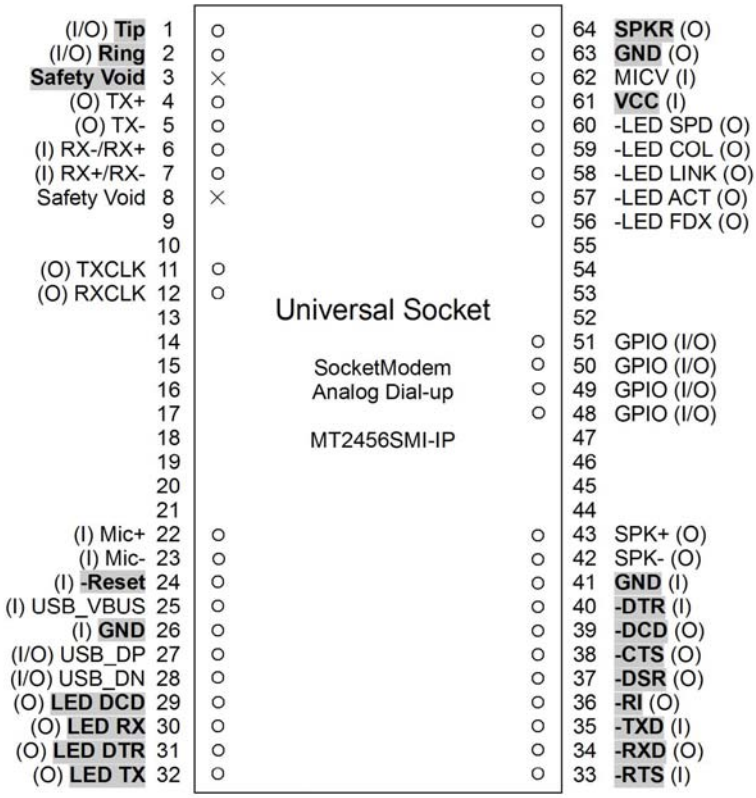
SocketModem Configuration

Serial Configuration

The SocketModem IP uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: 5-Volt Tolerant Signal Inputs are –DTR –TXD, –RTS and –RESET.

Drawing Note: The **bolded, shaded pins** are the **active** SocketModem IP pins.



Top View
SocketModem IP Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Electrical Characteristics

3.3V Serial for Board Rev. G (or higher)

3.3VDC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DTR (40), –TXD (35), –RTS (33) **Note:** These digital inputs are 5V tolerant	**Input High** Min 2.0V	**Input Low** Max 0.8V	
Digital Inputs –RESET (24) **Note:** These digital inputs are 5V tolerant	**Input High** Min 2.0V	**Input Low** Max 0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

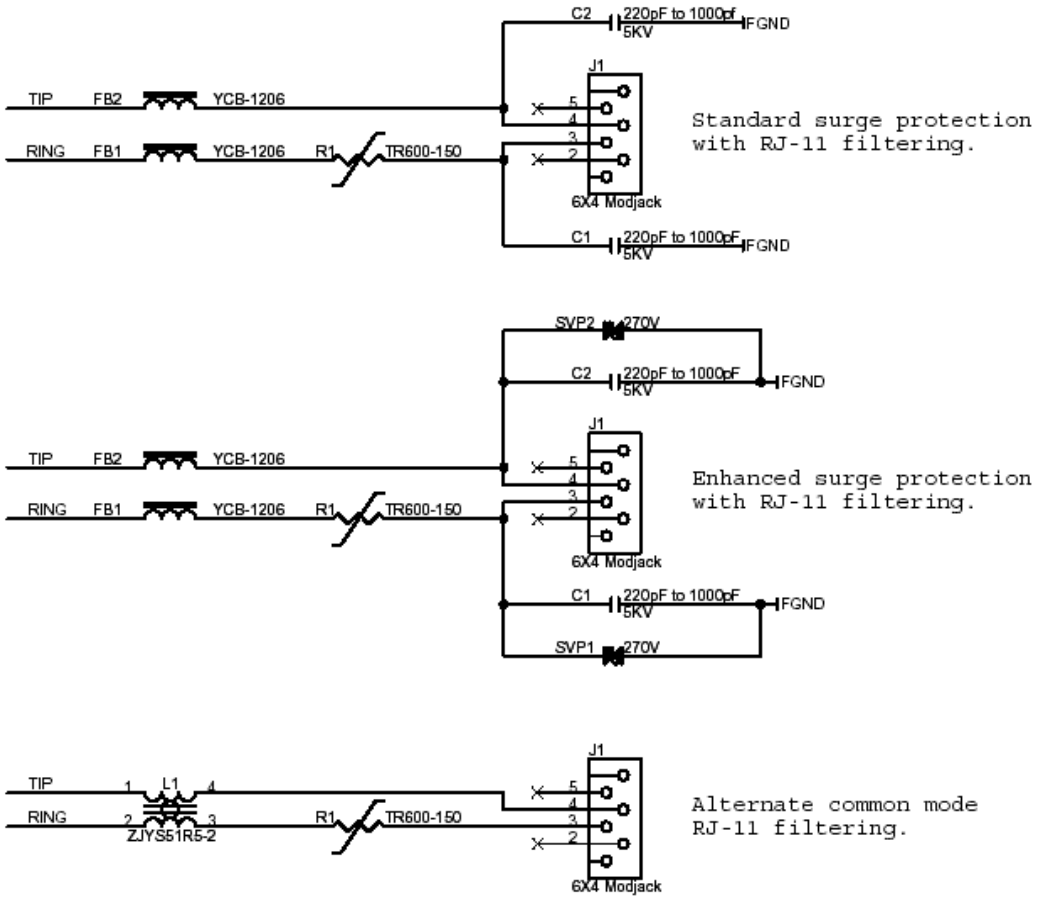
3.3V Serial for Board Rev. A through F

3.3VDC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 2.52V	**Input Low** Max 0.8V	
Digital Inputs –RESET (24) **Note:** These digital inputs are 5V tolerant	**Input High** Min 2.52V	**Input Low** Max 0.3V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

Application Notes

Tip and Ring Interface



OEM Motherboard

Filtering and Surge Protection

See *Design Considerations* and *Recommended Parts* in Chapter 1.

Chapter 6

SocketEthernet IP®

MTXCSEM
MTXCSEM-L
MTXCSEM-L-HV
MTXCSEM-L-RAS
MT100SEM

Chapter 6 – SocketEthernet IP (MTXCSEM, MTXCSEM-L-RAS, & MT100SEM)

Introduction

The **SocketEthernet IP** (MTXCSEM & MT100SEM) device server connects serial devices to an IP network for remote monitoring, control and configuration. The space efficient module (1" x 2.5") integrates a high performance Ethernet bridge as well as a complete TCP/IP protocol stack into a single, universal socket design. The SocketEthernet IP can make your existing and next generation device, machine, or system, IP-ready while you focus on developing its core features.

The **SocketEthernet IP RAS** (MTXCSEM-L-RAS) embedded device server, when paired with a SocketModem such as the MT5634SMI, provides connectivity to the corporate LAN for telecommuters and mobile users, or to remotely installed equipment. The SocketEthernet IP RAS device server is a full-featured, turnkey remote access solution that provides seamless interoperability to any TCP/IP network. This Technical Specifications in this chapter apply to the SocketEthernet IP functionality of the SocketEthernet IP RAS. For more information, see the SocketEthernet IP RAS Technical Reference Guide.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTXCSEM			
MTXCSEM.Rx	Embedded Serial-to-Ethernet Device Server – 5V	Global	
MTXCSEM-L.Rx	Embedded Serial-to-Ethernet Device Server – 3.3V	Global	
MTXCSEM-L-HV.Rx	Embedded Serial-to-Ethernet Device Server – 3.3V – Medical		
MTXCSEM-L-RAS.Rx	Embedded RAS Device Server – 3.3V	Global	
MT100SEM			
MT100SEM	Embedded Serial-to-Ethernet Device Server – 5V	Global	
MT100SEM-L	Embedded Serial-to-Ethernet Device Server – 3.3V	Global	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

L	3.3 Volt
HV	High Voltage 1.5KV Dielectric Isolation (Medical)
RAS	Remote Access Server
UDK	Universal Developer Kit

Other Product Codes:

R*x*	"R" indicates product revision. "*x*" is the revision number.

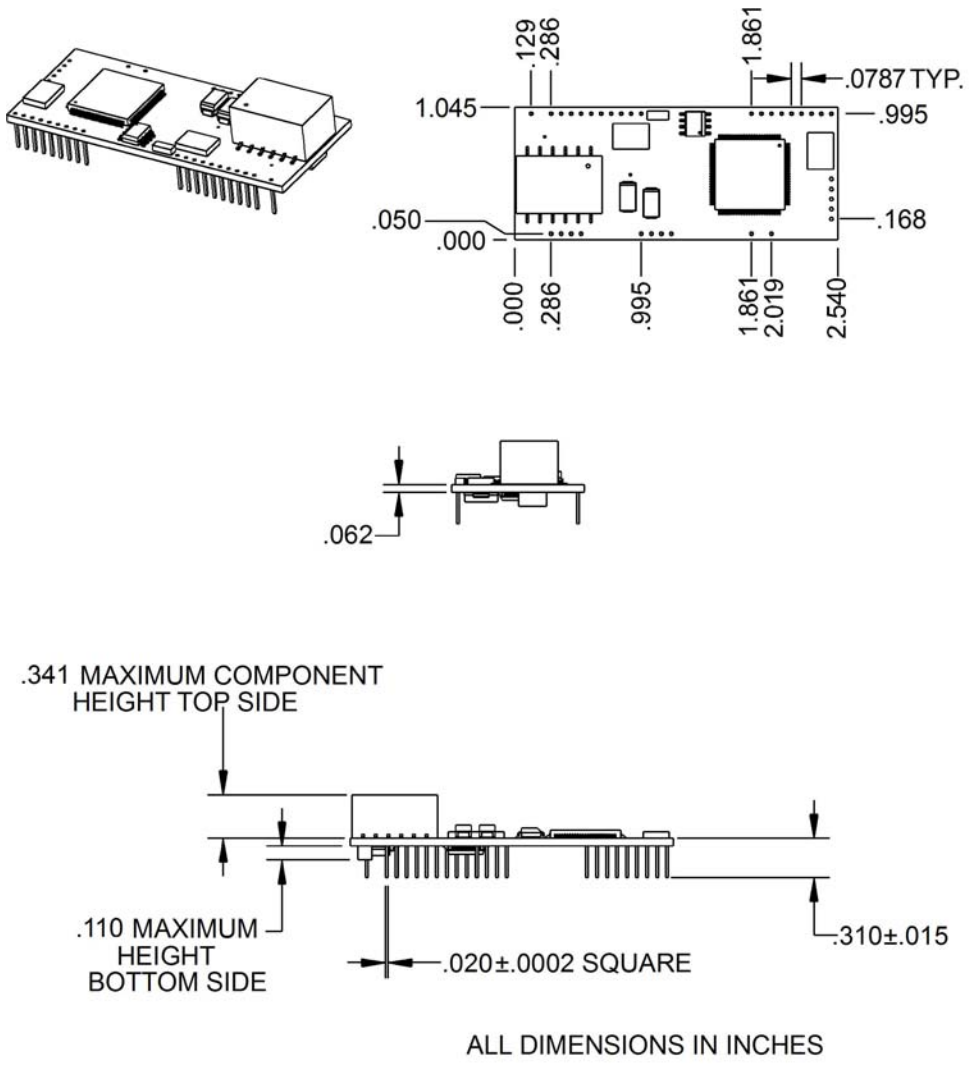
Technical Specifications

The SocketEthernet IP (MTXCSEM and MTXCSEM-L-HV) meets the following specifications:

Category	*Description*
Data Standards	**LAN Interface:** 10/100BaseT Ethernet **Ethernet Interface:** IEEE 802.3
Data Formats	Serial, binary, asynchronous
Character Format	8N1 – setable
Serial/Data Speeds	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps
Ethernet Data Speeds	10mbps or 100mbps
Dimensions	2.541" L x 1.045" W x 0.680" H (6.45cm x 2.65cm x 1.7cm)
Weight	0.6 oz. (0.017 kg.)
Operating Temperature	0° to +70° C
Storage Temperature	-40° C to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	5VDC or 3.3VDC
Power Requirements	**MTXCSEM** **3.3V** Ethernet @ 10mbps Typical – 230mA Maximum – 270mA Ethernet @ 100mbps Typical – 260mA Maximum – 300mA **5V** Ethernet @ 10mbps Typical – 240mA Maximum – 280mA Ethernet @ 100mbps Typical – 270mA Maximum – 310mA **MT100SEM** **3.3V** Typical – 145mA Maximum – 160mA **5V** Typical – 140mA Maximum – 160mA
DAA Isolation	**MTXCSEM** Isolation not required (SELV) **MTXCSEM-L-HV** 1.5Kv r.m.s. or 1212VDC at working voltage of 250VDC
Flow Control	RTS/CTS (hardware)
Network Protocols Supported	**MTXCSEM** ARP, DHCP, DNS, FTP, HTTP, ICMP, IP, POP3, PPP bridging, SMTP, TCP, Telnet, TFTP, SNMP, SNTP, UDP **MT100SEM** ARP, DHCP, DNS, FTP, ICMP, IP, POP3, SMTP, TCP, Telnet, UDP
Management	Serial; Telnet
Security	Username and password authentication using local database (for MTSCSEM only)

Category	*Description*
Certifications & Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 CSA 950 AS/NZS 6950:2000 **Safety Certifications for High Voltage Build** UL 60601-1 EN 60601-1 **EMC Approvals** FCC Part 15 Class B Canada Class B EN 55022 Class B EN 55024
Warranty	2 years
Intelligent Features	AT Command Compatible (MT100SEM) Web-base or command line configuration (MTXCSEM) LED driver outputs for visual monitoring speed, link, activity, collision and duplex mode The Heartbeat LED on the module constantly blinks when the module is running or booting up. If it stays on without blinking or is off, then the module is locked up. The Heartbeat LED may not be present on some older models. Half duplex or full duplex support on the LAN interface 256 frame buffer for Ethernet bridging (MTXCSEM) Stores 10,000 MAC addresses (MTXCSEM) Automatically learns MAC addresses (MTXCSEM) Web server supports 30K of HTML Web pages (MTXCSEM) Central site setup and control of the remote modules Flash memory to update firmware with the latest enhancements

Mechanical Dimensions for the MT100SEM



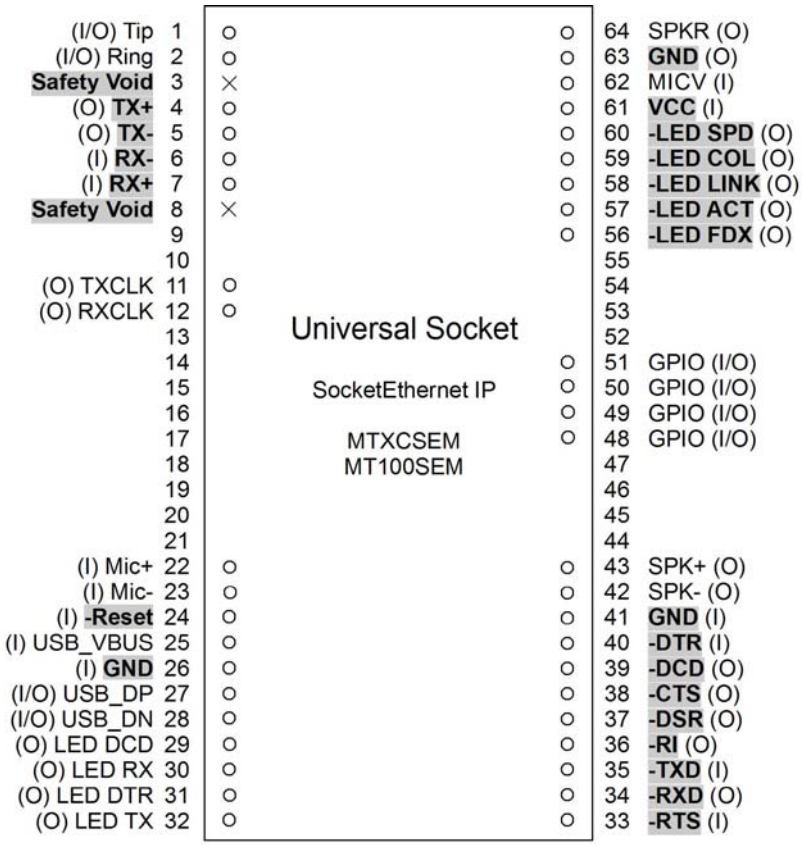
SocketModem MT100SEM Mechanical Drawing

SocketModem Configuration

Serial Configuration

The SocketEthernet IP uses a 22-pin interface to provide an on-board Ethernet media access controller, an Ethernet physical layer (without the RJ-45 jack), an LED driver for Ethernet monitoring, and a serial interface.

Note: The **shaded, bolded pins** are SocketEthernet IP **active** pins.



Top View
SocketEthernet IP Pinout

Note: Pin 6 is RX- for the SocketEthernet IP. For ISDN, Pin 6 is RX+.
Pin 7 is RX+ for the SocketEthernet IP. For ISDN, Pin 7 is RX-.

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Electrical Characteristics

3.3V Serial

3.3VDC Characteristics (T_A = -40 °C to 85 °C; V_{DD} = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24) **Note: These digital inputs are 5 volt tolerant**	**Input High** Min 2.52V	**Input Low** Max 0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

5V Serial

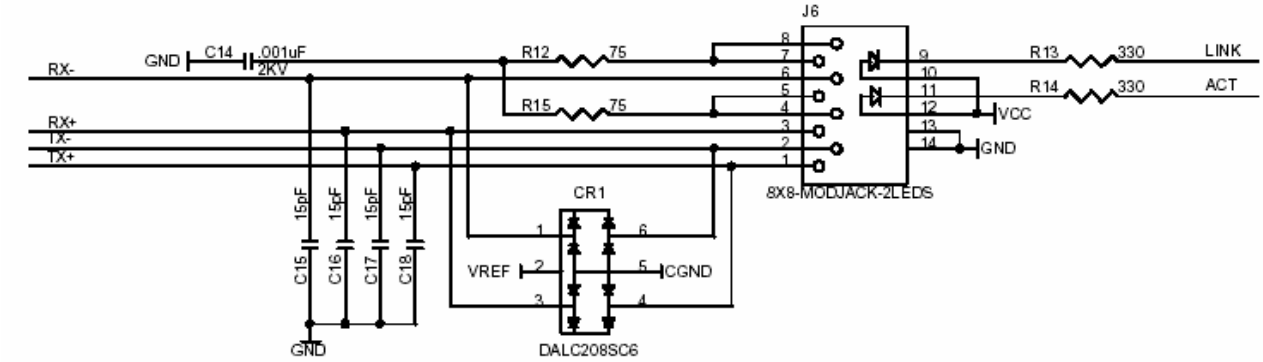
5VDC Characteristics (T_A = 0 °C to 50 °C; V_{DD} = 5V ± 0.25V) V_{DDMAX} = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	**Input High** Min 2.52V	**Input Low** Max .0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

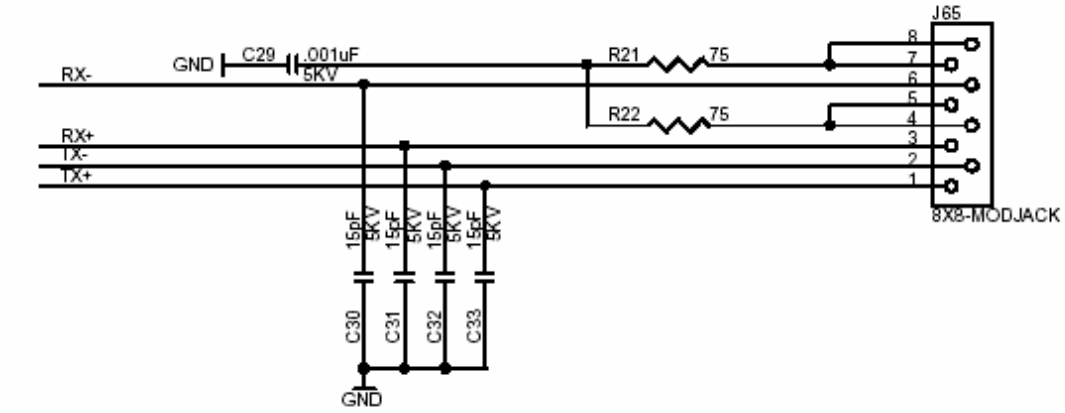
Application Notes

Ethernet Interface – Non-Isolated Design

Note: *VREF* stands for *Power* in this drawing.



Ethernet Interface – Isolated Design



Isolated Design Application Note

The MTXCSEM – HV was designed to meet Basic Isolation at 240Vac according to the international medical directive for safety (EN60601-1). The recommended components for an isolated design comply with the same standard.

Recommended Parts

Recommended Safety Rated Capacitors: The recommended capacitors are Y2 rated and meet supplementary isolation at 240Vac along with the required creepages and clearances.

Manufacture – NOVACAP
Part Number – ES2211N(value)K502NXT

Recommended Resistor: The resistors are 75 ohms 1/8 watt.

Recommended Ethernet Modular Jack: The recommended jack is an eight contact, eight position, unshielded and ungrounded connector that will maintain the need isolation and spacing requirements. A shielded and grounded connector may be used, but special consideration must be made for the isolation and spacing requirements.

Manufacture – Stewart Connector Systems
Part Number – SS-6488-NF-K1

Note: These SocketEthernet parts are RoHS compliant.

Chapter 7

SocketModem® ISDN

MT128SMI

Chapter 7 – SocketModem ISDN (MT128SMI)

Introduction

The Multi-Tech SocketModem ISDN creates communication-ready devices by integrating BRI ISDN functionality and S/T interface into a single, universal socket design. The space-efficient (1" x 2.5") embedded modem provides bi-directional communication bandwidth of up to 128K bps. This complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT128SMI.Rx	64/128K ISDN BRI Modem, S/T Interface 5V	Euro/ROW	
MT128SMI-L.Rx	64/128K ISDN BRI Modem, S/T Interface 3.3V	Euro/ROW	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

L	3.3 Volt
UDK	Universal Developer Kit

Other Product Codes:

R*x*	"R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketModem ISDN (MT128SMI) meets the following specifications:

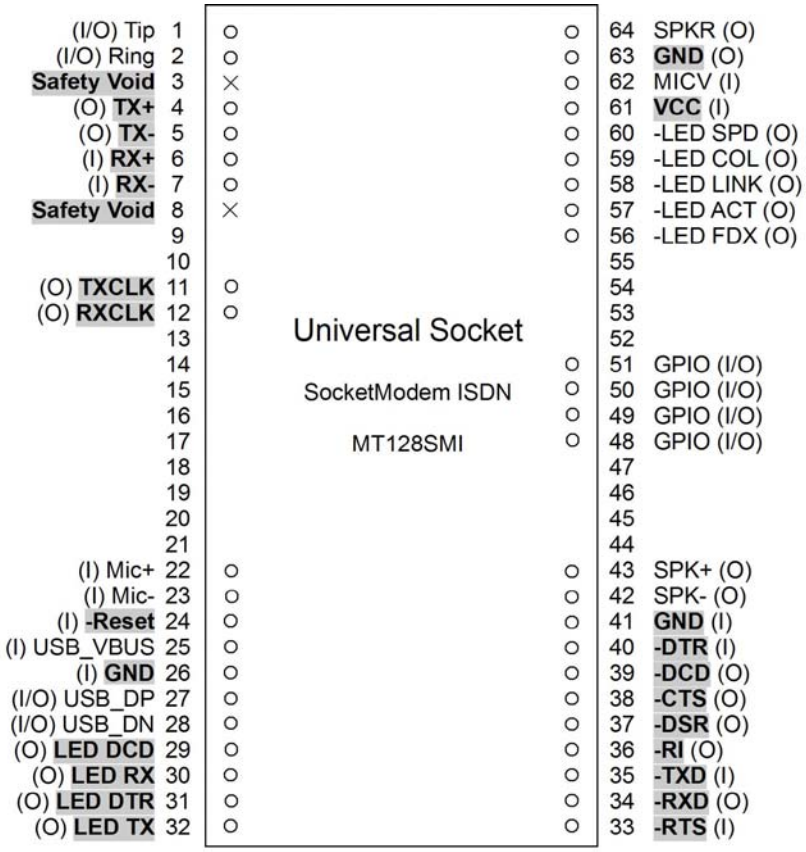
Category	*Description*
Data/Protocol Standards	PPP, ML-PPP, MP+, V.120, X.75, raw HDLC, CLEAR (synchronous), CHAP MD5, PAP, & Soft Bond, X.31-D (async, X.31 Case B X.25 over D-channel), X.31-B (async, X.31 Case A X.25 over B-channel)
Data Format	Serial, asynchronous, synchronous
Character Format	7 or 8 data bits; 1 or 2 stop bits; odd, even, none, mark, or space parity; 10-bit only
ISDN Speeds	64K bps/1 B-channel; 128K bps/2-channel; 16K bps/D-channel (for signaling)
Serial/Data Speeds	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps
Data Error Correction	Supported in V.120 and X.75 data protocols
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Dimensions	2.541” L × 1.045” W × 0.68” H (6.45 x 2.65 x 1.7 cm)
Weight	0.6 oz. (17 g)
Operating Temperature	0° to 70°C
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	5VDC or 3.3VDC
Power Requirements	Typical: 160mW @ 3.3V; 510mW @ 5V Maximum: 182mW @ 3.3V; 543 mW @ 5V
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	200 characters
ISDN Switch Types	U.S. National ISDN-1, AT&T 5ESS Custom, Northern Telecom DMS-100 Custom, ETSI/DSS1/NET3 (Euro ISDN), Japan NTT INS64, France VN-4
ISDN Service	2B+D
ISDN Interface	Four-wire S/T Basic Rate Interface (BRI)
Certifications & Approvals	**Certification:** CE Mark **Safety Certifications:** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals:** FCC Part 15 Class A EN 55022 EN 55024 **Telecom:** TBR3
Warranty	2 years
Intelligent Features	Calling line identification reporting (caller ID) Command Line API for Internet configuration AT command compatible in modem mode Complete data modem solution, including the controller and S/T interface in one module Flash memory to update firmware with the latest enhancements

SocketModem ISDN Configuration

Serial Configuration

The MT128SMI SocketModem uses a 23-pin interface.

Note: The bolded, shaded pins are the MT128SMI active pins.



Top View
SocketModem ISDN Pinout

Note: Pin 6 is RX+ for ISDN. For the SocketEthernet IP, Pin 6 is RX-. Pin 7 is RX- for ISDN. For the SocketEthernet IP, Pin 7 is RX+.

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Electrical Characteristics

3.3V Serial SocketModem ISDN

3.3VDC Characteristics (TA = 0° C to 70° C; VDD = 3.3V ± 0.3V) V_{DDMAX} = 3.6V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0V	Max 0.8V	
–RESET (24)	Min 2.0V	Max 0.8V	
RX+, RX- (S/T Interface Receive)	Min 90mV Peak Normal Mode	Min 220mV Peak Sleep Mode	
Input Capacitance			15 pF
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34), TCLK (11), RCLK (12)	Min 2.4V	Max 0.5V	3.2mA, 7.0mA for TXD
TX+, TX- (S/T Interface Transmit)	1.17V peak @ 6mA RL= 50 ohms		

5V Serial SocketModem ISDN

5VDC Characteristics (TA = 0° C to 50° C; VDD = 5V ± 0.25V) V_{DDMAX} = 5.25V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0V	Max 0.8V	
–RESET (24)	Min 2.0V	Max 0.8V	
RX+, RX- (S/T Interface Receive)	Min 90mV Peak Normal Mode	Min 220mV Peak Sleep Mode	
Input Capacitance			15 pF
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34), TCLK (11), RCLK (12)	Min 4.0V	Max 0.5V	3.2mA, 7.0mA for TXD
TX+, TX- (S/T Interface Transmit)	1.17V peak @ 6mA RL= 50 ohms		

Application Notes

Safety Warning Telecom / ISDN-ST

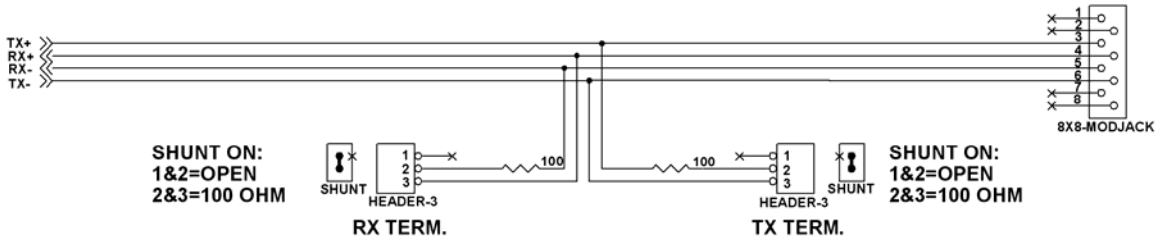
This device is for connection to the ISDN S/T side of an ISDN NT1 device only.

Interface Connector Contact Assignments

Pole (contact) assignments for 8-pole connections (plugs and jacks; i.e., RJ-45)

Pole Number	Function		I.430 Polarity	Optional Polarity
	TE	NT		
3	Transmit	Receive	+	+
4	Receive	Transmit	+	–
5	Receive	Transmit	–	+
6	Transmit	Receive	–	–

ISDN Interface



Termination Resistors: When operating as a TE in point-to-point mode, termination resistors are also required. However, when configured as a TE in passive bus arrangement, only one TE has these termination resistors.

Note: The MT128SMI ships with a transformer/choke module on it; and therefore, extra EMC filtering on the S/T interface should not be necessary. Extra filtering may actually degrade the ISDN pulse shape and put the unit into nonconformity with I.430.

Chapter 8

SocketModem® GPRS

MTSMC-G

Chapter 8 – SocketModem GPRS (MTSMC-G)

Introduction

The SocketModem GPRS wireless modem is a complete, ready-to-integrate module that offers standards-based multi-band GPRS Class 10 performance. It is based on industry-standard open interfaces and utilizes Multi-Tech's universal socket design.

Notes about Activation:

- These units are shipped without network activation.
- To connect to the wireless network, you will have to establish a wireless account. See the Wireless Activation procedures in separate documents included with the Developer Kit and available on the Developer Kit CD.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTSMC-G-F1.Rx	900/1800 MHz GPRS SocketModem 5V	Europe/Asia/Africa	
MTSMC-G-F2.Rx	850/1900 MHz GPRS SocketModem 5V	North/South America	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

G	GPRS
F1	900/1800 MHz
F2	850/1900 MHz
UDK	Universal Developer Kit

Other Product Codes:

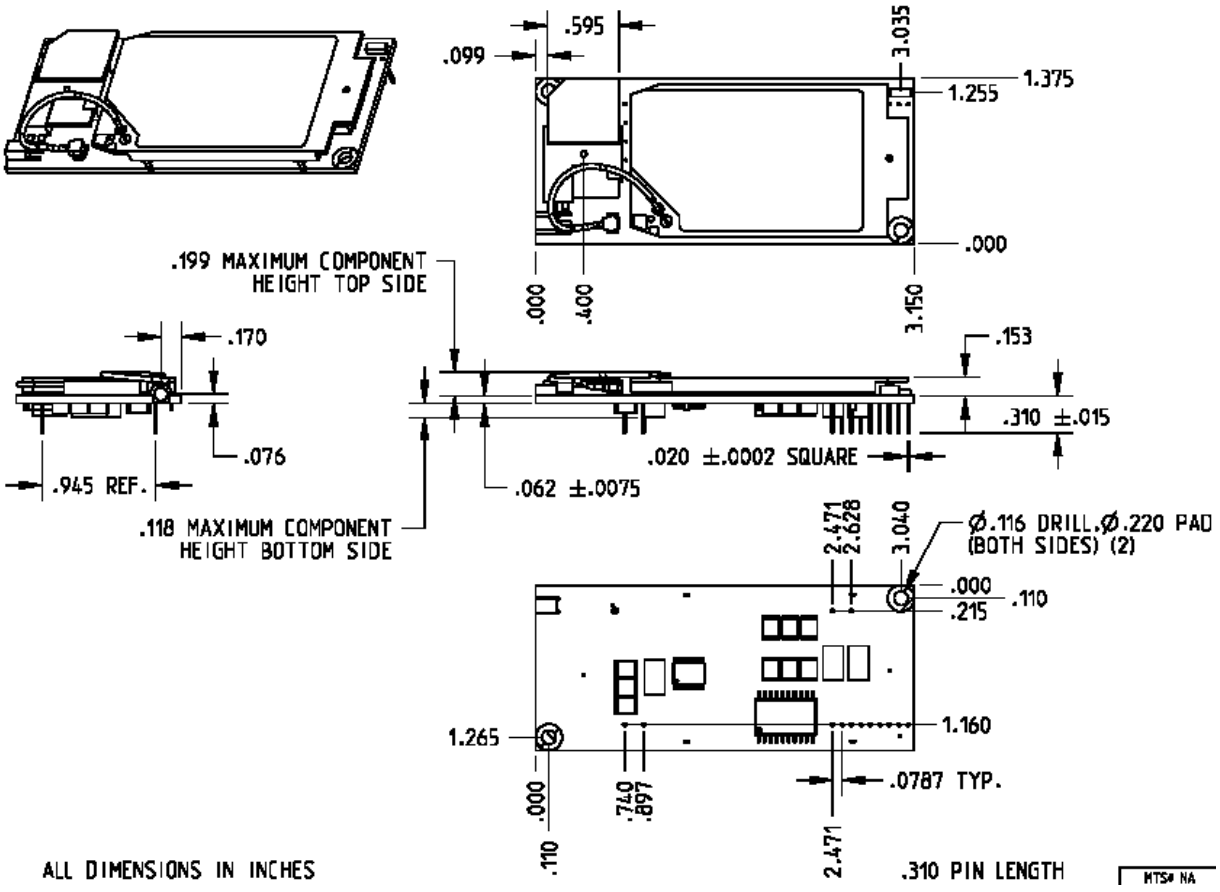
R*x*	"R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketModem GPRS (MTSMC-G) meets the following specifications:

Category	*Description*
Standards	GPRS Class 10
Bandwidth	Dual-band 850/1900 or 900/1800 MHz GSM/GPRS
Serial/Data Speed	Serial interface supports DTE speeds to 115.2K Packet data up to 85.6K bps Circuit-switched data (GPRS) up to 14.4K bps transparent and non-transparent
Data Format	Asynchronous, transparent and non-transparent
Data Error Correction	MNP2
Data Compression	V.42bis
Fax Compatibility	GSM
Fax Class	Class 1 and Class 2 Group 3
Dimensions	3.1” L x 1.4” W x 0.5” H (8.0 cm x 3.5 cm x 1.2 cm)
Weight	1 oz. (0.026 g)
Operating Temperature	-30° to +70° C (FCC certified operating temperature range is -30° to +50° C)
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	5VDC
Power Requirements	**5V:** Typical 300mA Maximum 1.3A
Connectors	Antenna: MMCX SIM: Standard 3V SIM receptacle (5V SIM with external level shifter)
IP Protocols Supported	ARP, Dial-in PPP, DNS Resolve, FTP client, ICMP, IP, IPCP, LCP, POP 3 (receive mail), PPP, SMTP (send mail), TCP socket, Telnet client, Telnet server, CHAP, PAP
Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals** FCC Part 2, 15, 22, 24 EN 55022 EN 55024 **Network** PTCRB
Warranty	Two years
Features	Embedded TCP/IP stack with UDP and PING support Short Message Services (SMS) Features: Text and PDU, Point-to-Point, Cell broadcast AT command compatible Management Features: Phone book management, Fixed dialing number, Real time clock, Alarm management Support for AMR (Adaptive Multi Rate) voice coder Support for Cellular Text Telephone Modem Large Memory SIM support to store/recall more than 127 text messages (SMS) Large Memory SIM support to store/recall more than 127 entries per phonebook Ability to select the ADN phonebook when FDN service is enabled 60-digits per phonebook entry (ADN, FDN, LDN) 60-digit phone numbers Modem can dial a phone number that is not in the FDN list Can select active or passive mode transfers in FTP mode Can predefine two TCP server settings (only one can be connected at a time)

Mechanical Dimensions



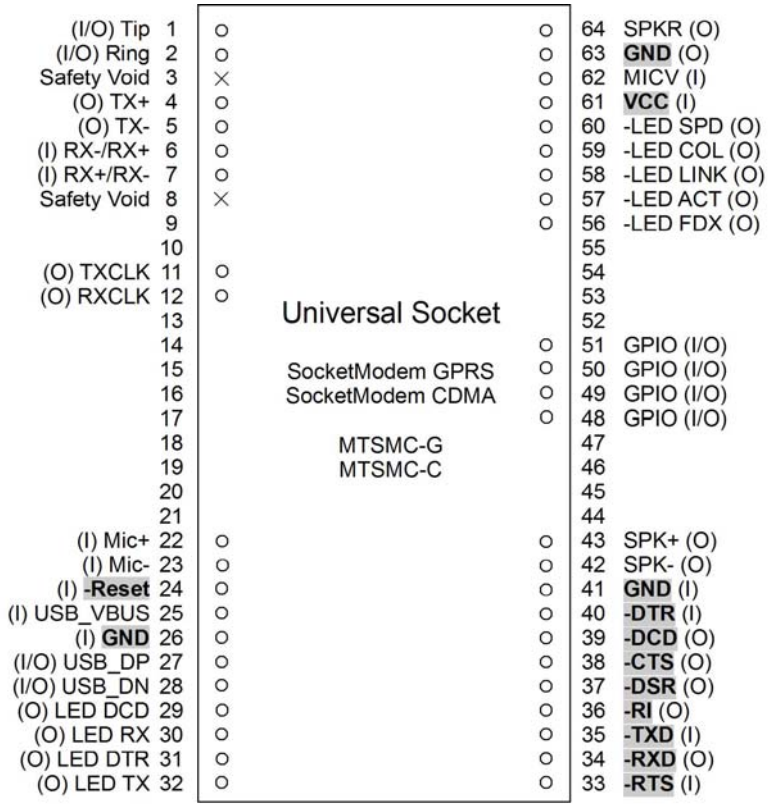
SocketModem GPRS Mechanical Drawing

SocketModem Configuration

Serial Configuration

The SocketModem GPRS uses a 13-pin interface.

Note: The **bolded, shaded pins** are the SocketModem GPRS **active** pins.



Top View

SocketModem Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

GPRS Electrical Characteristics and Power Consumption

Electrical Characteristics

5V DC Characteristics (TA = -30° C to +70° C; VDD = 5V ± 0.25V) $_{VDDMAX}$ = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 2.0V	**Input Low** Max 0.8V	
–RESET	**Input High** Min 2.0V	**Input Low** Max 0.5V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min 4V	**Output Low** Max 0.4V	**Current Drive:** 2mA
Digital Input Capacitance			**5 pF**

Power Consumption

Power Consumption in EGSM900 and GSM850 @ 25 degrees C

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 2W	1.2 A	1.3 A
+5V	Average @ 2W	250mA	320mA
+5V	Average @ 0.5W	180mA	200mA
+5V	Average idle mode	15mA	25mA

Power Consumption in GSM1800 & 1900 MHz @ 25 degrees C

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @1W	1.1 A	1.2 A
+5V	Average @1W	210mA	235mA
+5V	Average @ 0.25W	165mA	185mA
+5V	Average idle mode	15mA	25mA

Power Consumption in EGSM/GPRS 900 MHz and GSM/GRPS 850 MHz Mode Class 10

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 2W	1.2 A	1.3 A
+5V	Average @ 2W	420mA	470mA
+5V	Average @ 0.5W	280mA	320mA
+5V	Average idle mode	15mA	25mA

Power Consumption in GSM/GRPS 1800 MHz and GSM/GRPS 1900 MHz Class 10

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 1W	1.1 A peak	1.2 A peak
+5V	Average @ 1W	350mA	400mA
+5V	Average @ 0.25W	180mA	210mA
+5V	Average idle mode	15mA	25mA

Application Notes

Flashing LED Interface

The flashing LED signal is used to indicate the working mode of the SocketModem.

LED and SocketModem Status

Signal	SocketModem Status	
OFF	Download mode or switched OFF>	
ON	Continuously lit	Switched ON (not registered on the network)
	Flashing	Switched ON (registered on the network)

RF Interface

Radio Characteristics

	GSM 850	EGSM 900	GSM 1800	GSM 1900
Frequency RX	869 to 894 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
RF Power Stand	2W at 12.5% duty cycle	2W at 12.5% duty cycle	1W at 12.5% duty cycle	1W at 12.5% duty cycle
Impedance	50 ohms			
VSWR	<2			
Typical Radiated Gain	0 dBi on azimuth plane			

RF Performances

RF performances are compliant with the ETSI recommendation 05.05 and 11.10.
The main parameters are:

Receiver Features

- EGSM Sensitivity : < -104 dBm
- GSM 1800/GSM 1900 Sensitivity : < -102 dBm
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Dynamic range : 62 dB
- Intermodulation : > -43 dBm
- Co-channel rejection : + 9 dBc

Transmitter Features

- Maximum output power (EGSM) : 33 dBm ± 2 dB
- Maximum output power (DCS/PCS) : 30 dBm ± 2 dB
- Minimum output power (EGSM): 5 dBm ± 5 dB
- Minimum output power (DCS/PCS): 0 dBm ± 5 dB
- H2 level : < -30 dBm
- H3 level : < -30 dBm
- Noise in 925 - 935 MHz : < -67 dBm
- Noise in 935 - 960 MHz : < -79 dBm
- Noise in 1805 - 1880 MHz : < -71 dBm
- Phase error at peak power : < 5 ° RMS
- Frequency error : ± 0.1 ppm max

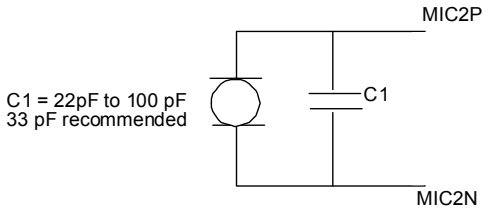
RF Connection

The RF connector on the SocketModem GPRS is an MMCX standard type. An antenna can be directly connected through a mating MMCX to SMA adapter as shown in *Peripheral Devices* on the next page.

Microphone Inputs

The MIC inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone has to be around 2K. These inputs are the standard ones for a handset design.

The gain of the MIC inputs is internally adjusted. The gain can be tuned from 30dB to 51dB. The connection to the microphone is direct.



Peripheral Devices

Antenna

An antenna with an SMA connector may be directly connected to a SocketModem GPRS through a mating MMCX to SMA adapter.

Antennas Available from Multi-Tech:

Description	Part Number
Hinged Right Angle 900/1800 MHz Cellular Modem Antenna	ANF1-1HRA
Hinged Right Angle 800/1900 MHz Cellular Modem Antenna	ANCF2-1HRA

Antenna Adapter Connector

The integrated modem antenna connector is an MMCX adapter. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size, which is 50% of the standard MCX connector.

This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm. The antenna manufacturer must guarantee that the antenna will be working according to the radio characteristics presented in the table on the previous page.

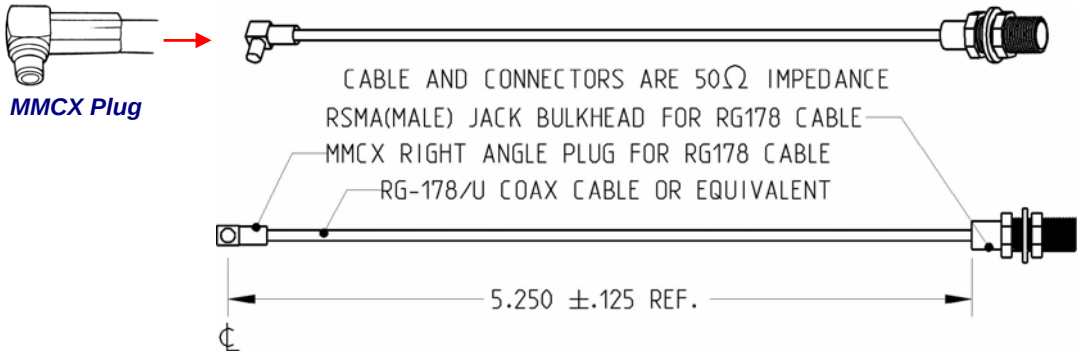
MMCX / SMA Connector Available from Amphenol

Amphenol http://www.amphenol.com/ Order No: 908-31100	

Antenna Cable

An optional 6” antenna cable (SMA Jack to MMCX Plug) can be ordered from **Multi-Tech Systems, Inc.**

Part Number	Description
CASMA-MMCX-1	SMA to MMCX COAX RF 6 inch cable (Single Pack)
CASMA-MMCX-10	SMA to MMCX COAX RF 6 inch cable (Ten Pack)


MMCX Plug
CABLE AND CONNECTORS ARE 50Ω IMPEDANCE
RSMA(MALE) JACK BULKHEAD FOR RG178 CABLE
MMCX RIGHT ANGLE PLUG FOR RG178 CABLE
RG-178/U COAX CABLE OR EQUIVALENT
5.250 ±.125 REF.
SMA Jack

Antenna Cable – SMA Jack to MMCX Plug

Chapter 9

SocketModem® CDMA

MTSMC-C

Chapter 9 – SocketModem CDMA (MTSMC-C)

Introduction

The Multi-Tech SocketModem CDMA is a complete, ready-to-integrate, embedded wireless modem. Designed for global use, it offers standards-based multi-band CDMA200 1x performance. The SocketModem CDMA is based on industry-standard open interfaces and utilizes Multi-Tech's universal socket design.

Notes about Activation:

- These units are shipped without network activation.
- To connect to the wireless network, you will have to establish a wireless account. See the Wireless Activation procedures in a separate document included with your Developer Kit and available on the Developer Kit CD.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTSMC-C-N1	SocketModem 800/1900 MHz CDMA 1xRTT – Generic Random A-Key	Regional	
MTSMC-C-N2	SocketModem 800/1900 MHz CDMA 1xRTT – Sprint (USA)	US	
MTSMC-C-N3	SocketModem 800/1900 MHz CDMA 1xRTT – Verizon (USA)	US	
MTSMC-C-N4	SocketModem 800 MHz CDMA 1xRTT with R–UIM	Regional	
MTSMC-C-N9	SocketModem 800/1900 MHz CDMA 1xRTT – Generic Zero A-Key	Regional	
MTSMC-C-N11	SocketModem 800/1900 MHz CDMA 1xRTT with R-UIM	Regional	
MTSMC-C-N12	SocketModem 800/1900 MHz CDMA 1xRTT – Bell Mobility Canada	Canada	
MTSMC-C-N14	SocketModem 800/1900 MHz CDMA 1xRTT – Alltel (USA)	US	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

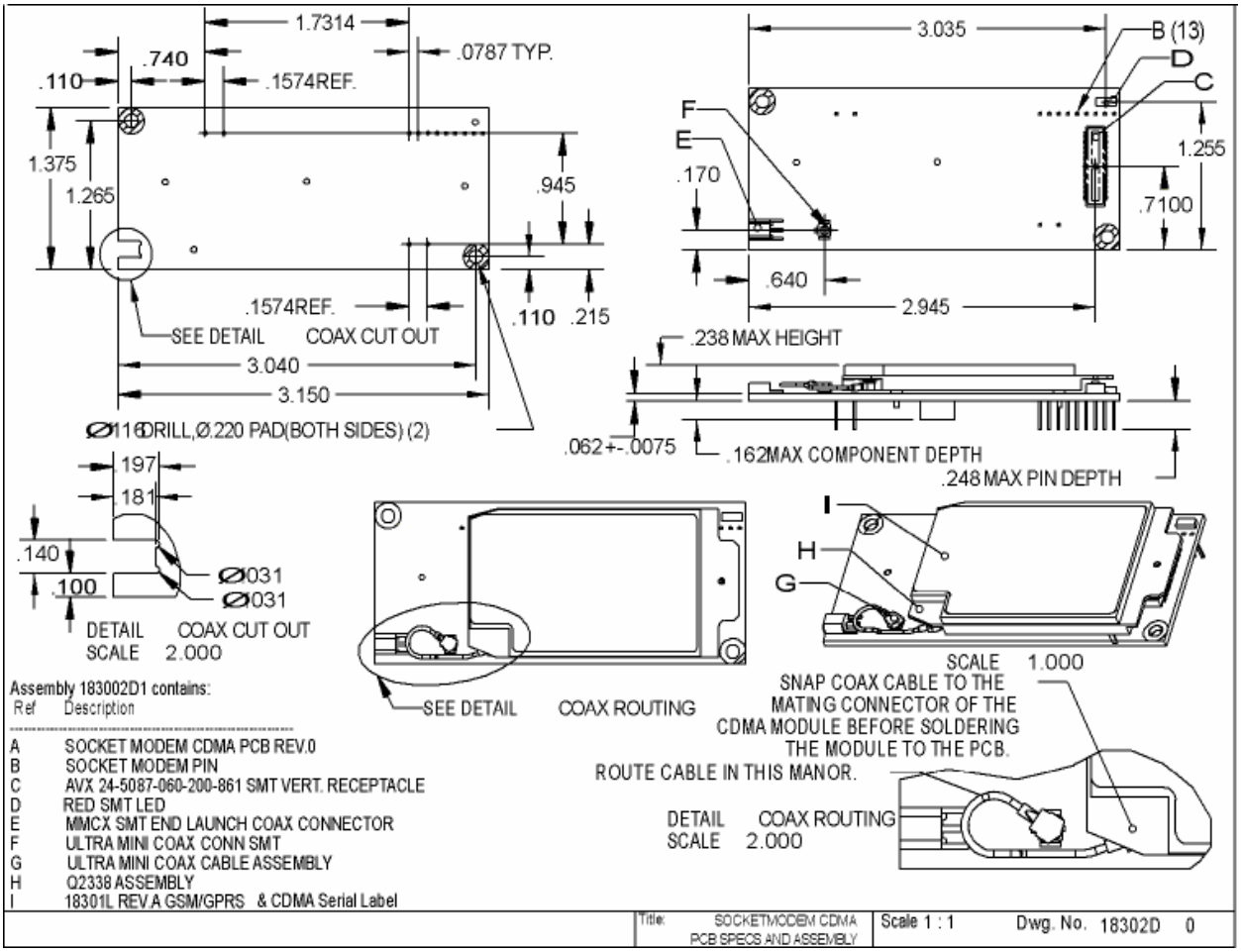
C	CDMA
N1	Generic Random A-Key. Requires provisioning. Must be programmed with Provisioning Information (PRI) and a Preferred Roaming List (PRL).
N2	Sprint USA
N3	Verizon USA
N4	800 MHz with R-UIM
N9	Generic Zero A-Key. Requires provisioning. Must be programmed with Provisioning Information (PRI) and a Preferred Roaming List (PRL).
N11	800/1900 MHz with R-UIM
N12	Bell Mobility Canada
N14	Alltel USA
UDK	Universal Developer Kit

Technical Specifications

The SocketModem CDMA (MTSMC-C) meets the following specifications:

Category	*Description*
Standard	CDMA2000 1xRTT
Bandwidth	Dual-band 800/1900 MHz CDMA
Serial/Data Speed	Serial interface supporting DTE speeds to 230K Packet data up to 153.6K bps forward and reverse channels Circuit-switched data up to 14.4K bps
Data Format	Asynchronous, transparent and non-transparent
Fax Class	Class 2.0 Group 3
Dimensions	3.1" L x 1.4" W x 0.5" H (8.0 cm x 3.5 cm x 1.2 cm)
Weight	1.2 oz. (34 g)
Operating Temperature	-30° to +70° C (FCC certified operating temperature range is -30° to +50° C)
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	5VDC
Power Requirements	**5V:** Typical: 400mA; Maximum: 700mA
Connectors	Antenna: MMCX R-UIM: Standard 3V R-UIM receptacle (For China only, 5V R-UIM)
Certifications & Approvals	**Safety Certifications** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals** FCC Part 2, 15, 22, 24 EN 55022 EN 55024 **Network** CDG 1 & 2
Warranty	2 years
Features	Short Message Services (SMS): Mobile originated; Mobile terminated Cell broadcast Over the Air Activation (OTA) OTASP; OTAPA SMS Features: Text & PDU, Point-to-Point, cell broadcast TCP/IP stack AT command compatible Management Features: Phone book management Fixed dialing number Real time clock Alarm management Supports AMR (Adaptive Multi Rate) voice coder Supports Cellular Text Telephone Modem

Mechanical Dimensions



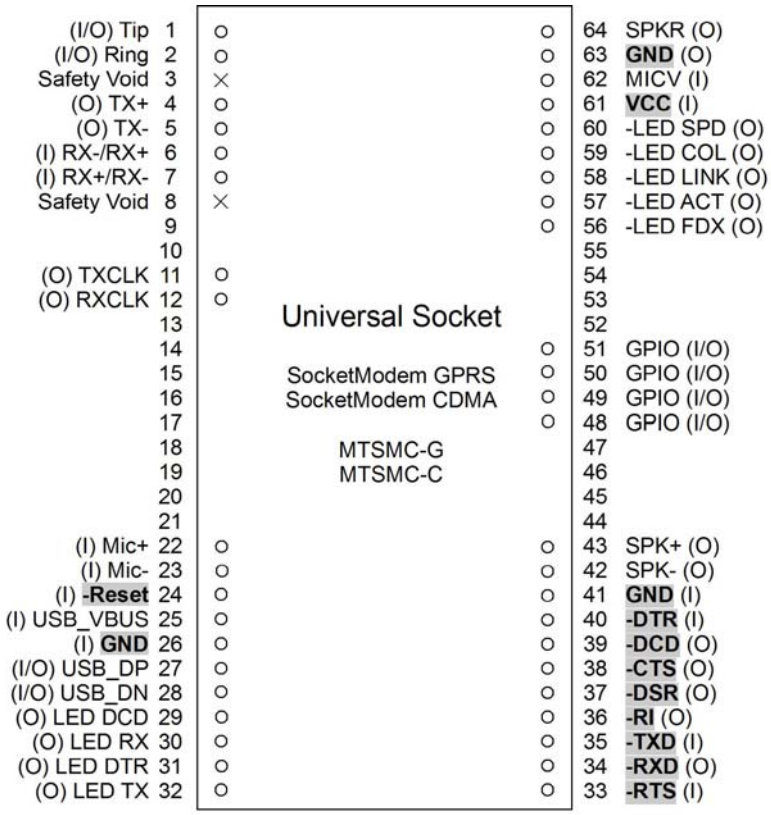
SocketModem CDMA Mechanical Drawing

SocketModem Configuration

Serial Configuration

The SocketModem CDMA uses a 13-pin interface.

Note: The **bolded, shaded pins** are the SocketModem CDMA **active** pins.



Top View – SocketModem CDMA Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

CDMA Electrical Characteristics

5VDC Characteristics (TA = -30° C to +70° C; VDD = 5V ± 0.2V) V_{DDMAX} **= 5.25V**			
Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 2.0V	**Input Low** Max 0.8V	
–RESET	**Input High** Min 2.0V	**Input Low** Max 0.5V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min 4V	**Output Low** Max 0.4V	**Current Drive:** 2mA
Digital Input Capacitance			**5 pF**

CDMA Power Consumption

Operating Mode	Band	Average (mA)
CDMA RXTX	Cellular	615
Full Power	PCS	770
CMA RXTX	Cellular	340
Average Power	PCS	445
CDMA Standby	Cellular	20
	PCS	20

Application Notes

Flashing LED Interface

The flashing LED signal is used to indicate the working mode of the SocketModem.

LED and SocketModem Status

Signal	SocketModem Status	
OFF	Download mode or switched OFF>	
ON	Continuously lit	Switched ON (not registered on the network)
	Flashing	Switched ON (registered on the network)

RF Interface

Radio Characteristics

	CDMA 800	CDMA 1900
Frequency RX	869 to 894 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	1850 to 1910 MHz
Impedance	50 ohms	
VSWR	<2	
Typical Radiated Gain	0 dBi in at least one direction	
Output Power	.63W in AMPS .35W in CDMA	

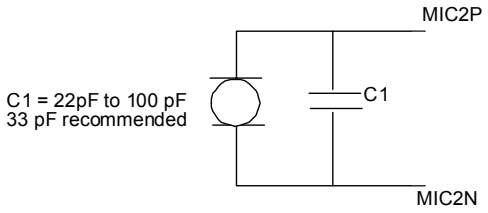
RF Connector

The RF connector is MMCX standard type. An antenna can be directly connected through the mating connector or using a small adapter.

Microphone Inputs

The MIC inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone has to be around 2K. These inputs are the standard ones for a handset design.

The gain of the MIC inputs is internally adjusted. The gain can be tuned from 30dB to 51dB. The connection to the microphone is direct.



Peripheral Devices

Antenna

An antenna with an SMA connector may be directly connected to a SocketModem CDMA through a mating MMCX to SMA adapter.

Antenna Available from Multi-Tech:

Description	Part Number
Hinged Right Angle 800/1900 MHz Cellular Modem Antenna	ANCF2-1HRA

Antenna Adapter Connector

The integrated modem antenna connector is an MMCX adapter. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size, which is 50% of the standard MCX connector.

This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm. The antenna manufacturer must guarantee that the antenna will be working according to the radio characteristics presented in the table on the previous page.

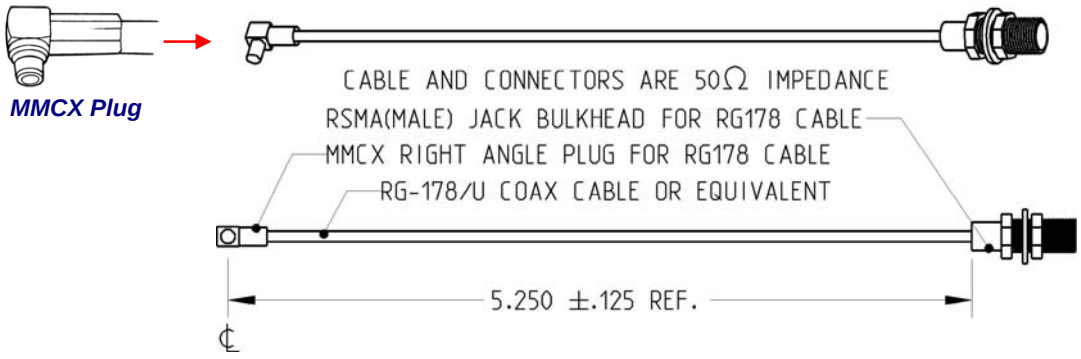
MMCX / SMA Connector Available from Amphenol

Amphenol http://www.amphenol.com/ Order No: 908-31100	

Antenna Cable

An optional 6” antenna cable (SMA Jack to MMCX Plug) can be ordered from **Multi-Tech Systems, Inc.**

Part Number	Description
CASMA-MMCX-1	SMA to MMCX COAX RF 6 inch cable (Single Pack)
CASMA-MMCX-10	SMA to MMCX COAX RF 6 inch cable (Ten Pack)


MMCX Plug
CABLE AND CONNECTORS ARE 50Ω IMPEDANCE
RSMA(MALE) JACK BULKHEAD FOR RG178 CABLE
MMCX RIGHT ANGLE PLUG FOR RG178 CABLE
RG-178/U COAX CABLE OR EQUIVALENT
5.250 ±.125 REF.
SMA Jack

Antenna Cable – SMA Jack to MMCX Plug

Provisioning a Generic SocketModem CDMA

The Difference Between a Pre-Provisioned SocketModem CDMA and a Generic SocketModem CDMA

Pre-Provisioned SocketModem CDMA

Multi-Tech offers several pre-provisioned SocketModem CDMA units (see the *Product Ordering Information* table at the beginning of this chapter). Pre-provisioned SocketModem CDMA builds are pre-programmed to operate only on a designated CDMA carrier's network; for example, the *MTSMC-C-N2* is pre-programmed (provisioned) for use on the Sprint network in the USA.

Generic SocketModem CDMA

Multi-Tech also offers two generic SocketModem CDMA models, the *MTSMC-C-N1 (Random A-Key)* and *MTSMC-C-N9 (Zero A-Key)*. These generic SocketModems are not pre-programmed to operate on any designated CDMA carrier's network.

Overview of the Provisioning Process

Requirements

- A generic SocketModem CDMA-C-N1 or -N9.
- ***AT Commands Reference Guide for the SocketModem CDMA***, Chapter 16.
- A developer software tool called ***WPST***.

Procedures

Step 1. Get the PRI and PRL from your wireless carrier.

Step 2. Set the provisioning commands, which are described in the ***AT Commands Reference Guide for the SocketModem CDMA***, Chapter 16, using the provisioning information provided by the CDMA wireless network carrier.

Step 3. Using the WPST tool, download the the carrier's specific PRI (Provisioning Information) and PRL (Preferred Roaming List) into the SocketModem CDMA.

The wireless modem is now provisioned and can be activated on your wireless carrier's network, according to the carrier's activation instructions.

See the Activation directions that accompany Multi-Tech wireless modems.

Provisioning Terminology

A-Key

The A-Key is a 64-bit cryptographic key variable stored in the semi-permanent memory of the mobile station and also known to the Authentication Center of the wireless carrier's system. The generation of the A-Key is the responsibility of the wireless service provider. It is established and entered when the mobile station is first put into service.

The CDMA network carrier you choose for you SocketModem CDMA product will let you know whether it uses the Random A-Key or the Zero A-Key in its authentication process. That will determine whether you purchase the -N1 or the –N9 build.

Provisioning

Provisioning is the programming of a SocketModem CDMA wireless modem to set the **PRI** and **PRL** provided by wireless network carrier that you are have chosen as your CDMA wireless network carrier. After the modem is provisioned, it can then be activated on the wireless network for which it is provisioned. Multi-Tech provides two SocketModems CDMA builds that are not pre-provisioned: MTSMC-C-N1 and MTCAB-C-N9.

PRI stands for Provisioning Information. Provisioning Information is your wireless network carrier's profile of parameter settings that must be programmed into your wireless modem in order for it to operate on the carrier's wireless network.

PRL stands for Preferred Roaming List. The PRL is a list of the wireless network service provider's preferred roaming partners. This list is downloaded from your network service provider during the provisioning process.

CDMA Terminology and Acronymns

This is an alphabetical list of the CDMA cellular industry's terminology and acronyms.

2G	**Second Generation.** This is an all digital cellular systems developed to replace the first analog cellular systems. (GSM and CDMA).
3G	**Third Generation.** This is the next generation digital cellular systems designed to have high-speed data access and higher voice capacity (CDMA & CDMA2000).
CBM	**Cell Broadcast Message.** This is an SMS message that is broadcast to all mobiles on the network.
CDMA	**CDMA** (**Code Division Multiple Access).** CDMA is a spread spectrum, digital wireless modulation scheme for cellular communications systems. It has approximately 3 times the voice capacity of GSM networks. See IS-95, IS-95B, IS-2000.
cdmaONE	**cdmaOne** is a brand name, trademarked and reserved for the exclusive use of the CDMA Development Group (see their Web site at cdg.org). cdmaOne describes a complete wireless system that incorporates the IS-95 CDMA air interface, the ANSI-41 network standard for switch interconnection and many other standards that make up a complete wireless system.
cdma2000	**cdma2000** is a third generation (3G) wireless system. It contains a significant increase in voice capacity and high-speed data rates. It is backward compatible with IS-95B and IS-95A.
cdma2000 1xRTT	"1xRTT" stands for 1 times Radio Transmission Technology and is used to identify the version of CDMA2000 radio technology that operates in a pair of 1.25-MHz radio channels (one times 1.25 MHz, as opposed to three times 1.25 MHz in 3xRTT). Although theoretically capable of higher data rates, most carrier implementations have limited the peak data rate to 144 kbit/s. While 1xRTT officially qualifies as 3G technology, 1xRTT is considered by some to be a 2.5G.
ESN	"ESN" stands for Electronic Serial Number. It is a 32-bit binary number that identifies each cellular phone.
Handset (Path)	**Handset (Path).** This is the audio path (microphone & speaker) that connects to a traditional hand held telephone receiver, usually dual balanced electrical lines.
Headset (Path)	**Headset (Path).** This is the audio path (microphone & speaker) that connects to an earpiece with a microphone, usually single electrical lines.
IMSI	**International Mobile Station IS.** This is an international 15 digital phone number that uniquely identifies a mobile. IMSI=MCC + MNC + MIN.
IOTA	**IOTA** stands for Internet Over The Air.
IS-95	**IS-95** is the first CDMA standard published by Qualcomm in 1993. It is a TIA standard for North American cellular systems based on CDMA. It is widely deployed in North America and Asia.
IS-95A	**IS-95A** is a CDMA standard with improved voice quality. IS-95A defines what generally is known as cdmaOne, which supports voice and 14.4 Kbps data rates.This standard is widely used throughout the world.
IS-95B	**IS-95B** is a CDMA standard contains Medium Data Rate capabilities and bug fixes for system access failures. It is considered a 2.5G system. It supports data rates up to 115 Kbps.
IS-2000	**IS-2000** is the first 3G CDMA standard based on IS-95B. It contains a significant increase in voice capacity and high-speed data rates. It is backward compatible with IS-95B and IS-95A.
IS-707	**TIA/EIA/IS-707** describes data services available on wideband spread spectrum systems. It is organized into a series of related recommendations, some of which address functions common to all CDMA data services and others that describe a specific data service.
MCC	**Mobile Country Code** is a pre-defined 30-digital number that represents a country in the IMSI.
MDN	**MDN** stands for Mobile Data Number or the mobile phone number.
MIN	**MIN** stands for Mobile Identification Number or mobile user account number.
MNC	**MNC** stands for Mobile Network Code, a pre-defined 2-digital number that represents a sub-network in the IMSI (usually set to "00").
MO	**MO** stands for Mobile Originated, an action (usually a call) that is first started from the phone. An outgoing call or SMS.
MS	**MS** stands for Mobile Station. The term MS is commonly used to represent the phone or mobile.
MT	**MT** stands for Mobile Terminated. MT is an action, usually a call, that is first started from a land based network. An incoming call or SMS.
MSM	**MSM** stands for Mobile Station Modem.

NAM	**NAM** stands for Number Assignment Modem. The NAM is collection of internal parameters that define a working phone for a given network (phone number, access parameters, etc.).
NID	**NID** stands for Network ID. The NID is an identification number that represents geographic location of a common coverage area; but is a subset of the SID, usually a neighborhood in a large city. NID is usually not used and is set to zero. Also see SID.
NV-RAM	**NV-RAM** stands for Non-Volatile Random Access Memory. NV-RAM is a data storage device that does not lose its data when power is turned off.
OTAPA	**OTAPA** stands for Over The Air Parameter Administration. It is an automatic update in internal software parameters (PRL for example) by means of a specially defined CDMA data call that is mobile terminated (MT).
OTASP	**OTASP** stands for Over The Air Service Programming. It is an automatic update in internal software parameters PRL; for example, PRL by means of a specially defined CDMA data call that is mobile terminated (MT).
P-REV	**P-REV** is the CDMA revision of the mobile or base station.
PDU	**PDU** stands for Protocol Data Unit. It is a GSM SMS standard whereby any type of binary data can be transported via an SMS message. In the CDMA system, the PDU mode will not be supported; instead, the Unicode format message is supported.
PN Offset	**PN Offset** stands for Pseudorandom Noise Offset. In a CDMA network the PN offset is a variable time delay offset of a repeating random noise generator that is used to distinguish individual sectors of a base station.
PRI	**PRI** stands for Provisioning Information. Provisioning Information is your wireless network carrier's profile of information that must be programmed into your wireless modem in order for it to operate on the carrier's wireless network.
PRL	**PRL** stands for Preferred Roaming List. The Roaming List is provided by the wireless network carrier during the process of provisioning your module. The PRL is a list of wireless service provider's preferred roaming partners.
PSTN	**PSTN** stands for Public Switching Telephone Network. It is the traditional telephone network.
RF	**RF** stands for Radio Frequency.
RSSI	**RSSI** stands for Receive Signal Strength Indicator: This parameter represents the total RF received signal power from the base station(s) the mobile sees.
R-UIM	**R-UIM** stands for Removable User Identity Module**.** The R-UIM is similar to a SIM (Subscriber Identity Module), but it is designed for networks other than GSM (Global System for Mobile Telecommunications); i.e., networks such as CDMA. The R-UIM card contains user information and data features on a removable smart card about the size of a postage stamp. It is a dual-mode solution that can store both GSM provisioning and CDMA provisioning on a single card. When used with a GSM handset, the R-UIM operates like a GSM SIM.
SID	**SID** stands for System ID. The SID is an identification number that represents geographic locations of a common coverage area, usually a large city. Also see NID.
SIM	**SIM** stands for Subscriber Identity Module. A SIM card is a portable memory chip. The SIM holds personal identity information, cell phone number, phone book, text messages and other data.
SMS	**SMS** stands for Short Messaging Service. it is a supplementart service that is capable of sending and receiving short length text messages to/from the mobile.
TA/TE	**TA/TE** stands for Terminal Application/Terminal Equipment. This is the end "device" (combination of hardware and software) that communicates with a modem via a serial link. In this context, it is the device (PDA/Computer) connected to the WISMO Quik. Also see DTE.

Chapter 10

SocketModem® EDGE

MTSMC-E

Chapter 10 – SocketModem EDGE (MTSMC-E)

Introduction

The Multi-Tech SocketModem EDGE embedded wireless modem delivers some of the fastest cellular data speeds by utilizing EDGE technology. It allows users to connect to the Internet and send and receive data up to three times faster than possible with an ordinary GSM/GPRS network making it ideal for highly data-intensive applications. Based on industry-standard open interfaces, the SocketModem EDGE wireless modem is equipped with quad-band GSM, which means it can be used worldwide on all existing GSM networks. In addition, it utilizes Multi-Tech's universal socket design.

Product Ordering Information

Product	Description	Region	Order This Product ✓
MTSMC-E.Rx	SocketModem Quad-band EDGE Class 10 – 5V	Global	
MTSMC-E-V.Rx	SocketModem Quad-band EDGE Class 10 w/Voice – 5V	Global	
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

E	EDGE
V	Voice
UDK	Universal Developer Kit

Other Product Codes:

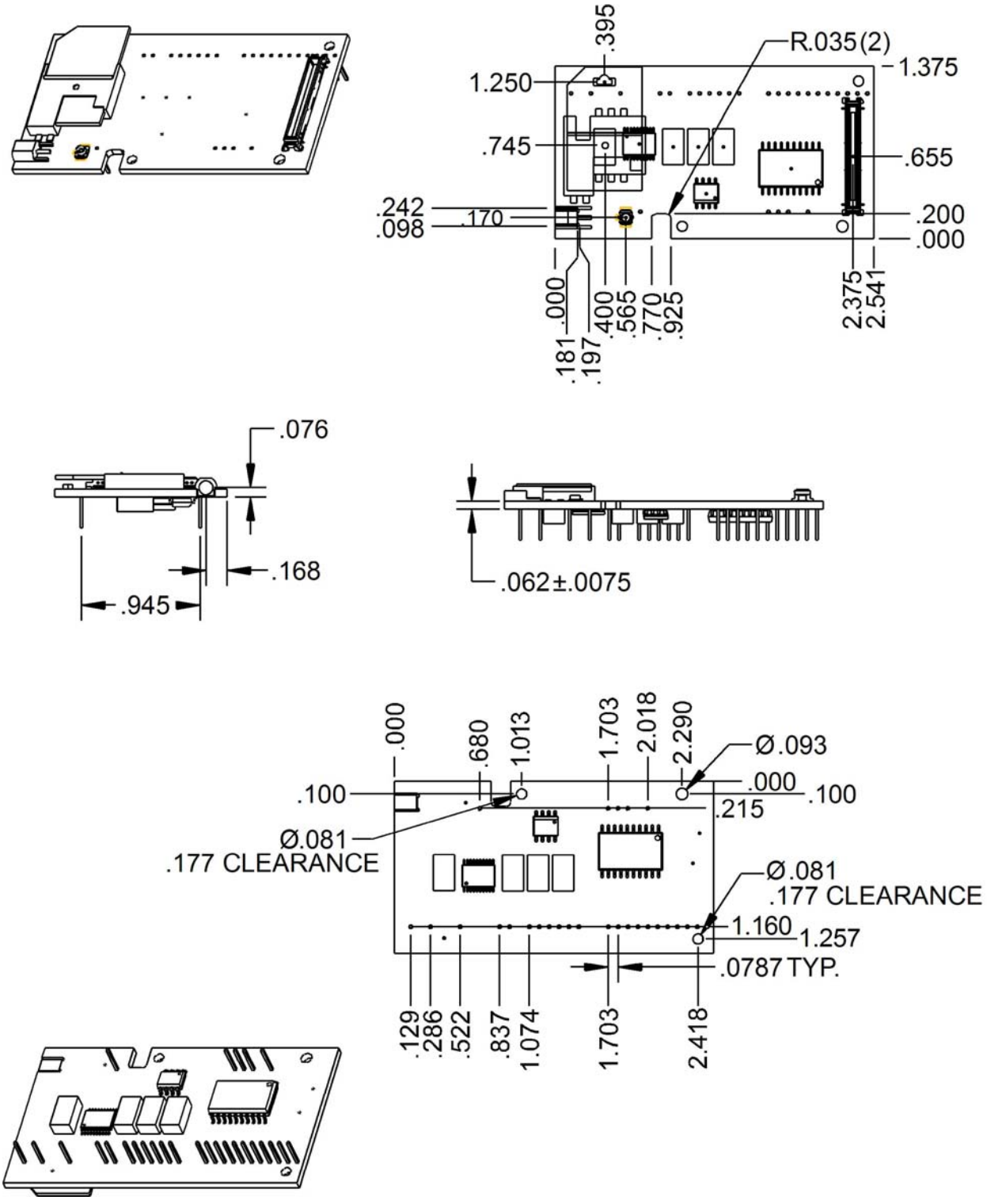
R*x*	"R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketModem EDGE (MTSMC- E) wireless modem meets the following specifications:

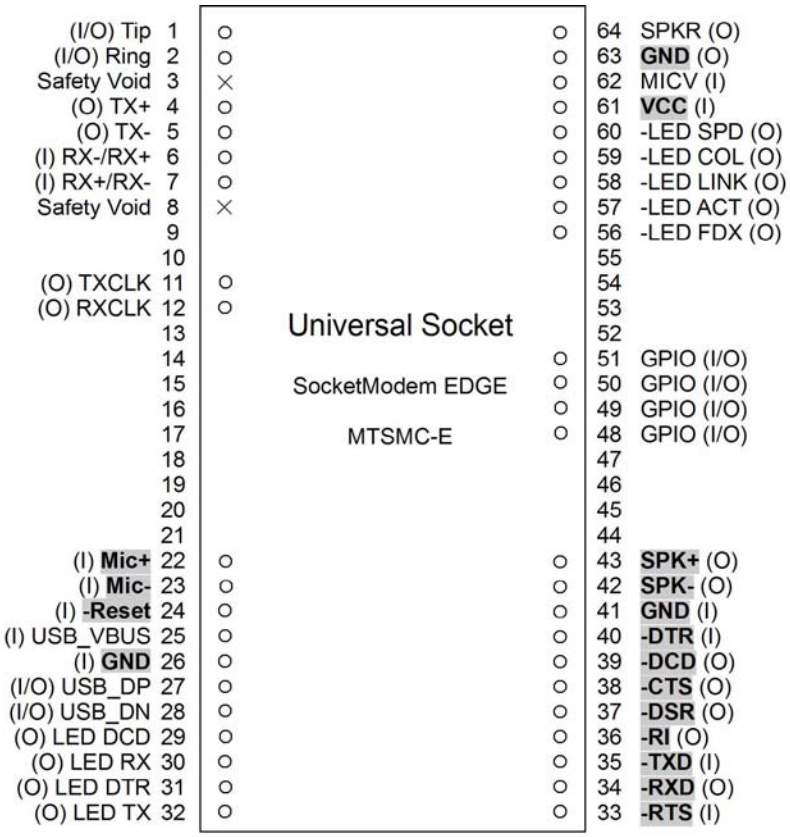
Category	Description
Standards	**EDGE:** E-GPRS Class 10 **GPRS:** GPRS Class 12
Data Speed	Packet Data rates up to 240K bps (modulation & coding scheme, MCS 1-9, Mobile station Class B) Circuit-switched data up to 14.4K bps non-transparent mode, asynchronous
Serial Speed	Serial interface supporting DTE speeds to 460K bps
Connectors	Antenna: MMCX SIM: Standard 3V SIM receptacle
IP Protocols Supported	TCP, UDP, DNS, FTP, SMTP, POP3, HTTP
Operating Voltage	5VDC
Power Consumption	**5VDC:** Typical: 400mA
Operating Temperature	-30° to +70° C (FCC certified operating temperature range is -30° to +50° C)
Storage Environment	-40° to +85° C
Humidity	20% to 90% non-condensing
Dimensions	2.55” L x 1.4” W x 0.5” H (6.48 cm x 3.5 cm x .87 cm)
Weight	1 oz. (0.028 kg.)
Certifications & Approvals	**Certifications:** CE Mark **Safety Certifications:** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals:** FCC Part 2, 15, 22, 24 EN 55022 EN 55024 **Network:** PTCRB
Warranty	2 years
Intelligent Features	SMS – Text & PDU, Point-to-Point, cell broadcast AT Command Compatible Voice features include Half Rate (HR), Full Rate (FR), Enhanced Full Rate (EFR), Adaptive multi rate (AMR), as well as hands free echo cancellation, and noise reduction Embedded TCP/IP protocol stack brings Internet connectivity

Physical Dimensions



SocketModem EDGE Wireless Modem Mechanical Drawing

Pin Configurations



Top View
SocketModem EDGE Pinout

Note: The following pins are used for the Voice build (MTSMC-E-V) only:
MIC+ (22)
MIC- (23)
SPK+ (43)
SPK- (42)

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

EDGE Electrical Characteristics

I/O Electrical Characteristics

5VDC Characteristics (TA = -30° C to 70° C; VDD = 5V ± 0.25V) VDDMAX = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	**Input High** Min 2.0V	**Input Low** Max 0.8V	
–RESET	**Input High** Min 2.6V	**Input Low** Max 1.0V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min 4V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

EDGE Power Consumption

Voice Mode Power Consumption

GSM Call Power Consumption in EGSM900 and GSM850 @ 25 degrees C

Voltage	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 2W	1.2 A	2.0 A
+5V	Average @ 2W	250mA	335mA
+5V	Average idle mode	28mA	35mA

GSM Call Power Consumption in GSM1800 & 1900 MHz @ 25 degrees C

Voltage	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 1W	1.1 A	1.6 A
+5V	Average @1W	210mA	285mA
+5V	Average idle mode	28mA	35mA

Data Mode Power Consumption

GPRS Class 10 Power Consumption in EGSM/GPRS 900 MHz and GSM/GRPS 850 MHz

Voltage	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 2W	1.5 A	2.0 A
+5V	Average @ 2W	400mA	610mA
+5V	Average @ 1W	280mA	488mA
+5V	Average idle mode	28mA	35mA

GPRS Class 10 Power Consumption in GSM/GRPS 1800 MHz and GSM/GRPS 1900 MHz

Voltage	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 1W	1.1 A peak	1.2 A peak
+5V	Average @ 1W	350mA	510mA
+5V	Average @ .25W	180mA	460mA
+5V	Average idle mode	28mA	35mA

EGPRS Class 10 Power Consumption in EGRPS 900 MHz and EGRPS 850 MHz

Voltage	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 5W	1.4 A peak	1.6 A peak
+5V	Average @ .5W	430mA	525mA
+5V	Average @ .25W	375mA	450mA
+5V	Average idle mode	28mA	35mA

Application Notes

Radio Characteristics

	GSM 850	EGSM 900	GSM 1800	GSM 1900
Frequency RX	869 to 894 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
RF Power Stand	2W at 12.5% duty cycle	2W at 12.5% duty cycle	1W at 12.5% duty cycle	1W at 12.5% duty cycle
Impedance	50 ohms			
VSWR	<2			
Typical Radiated Gain	0 dBi on azimuth plane			

Receiver Features

- EGSM Sensitivity : < -108 dBm
- GSM 1800/GSM 1900 Sensitivity : < -107 dBm
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Dynamic range : 62 dB
- Intermodulation : > -43 dBm
- Co-channel rejection : + 9 dBc

Transmitter Features

- Maximum output power (EGSM) : 24 dBm +/- 2 dB
- Maximum output power (DCS/PCS) : 30 dBm +/- 2 dB
- Minimum output power (EGSM): 5 dBm +/- 5 dB
- Minimum output power (DCS/PCS): 0 dBm +/- 5 dB
- H2 level : < -30 dBm
- H3 level : < -30 dBm
- Noise in 925 - 935 MHz : < -67 dBm
- Noise in 935 - 960 MHz : < -79 dBm
- Noise in 1805 - 1880 MHz : < -71 dBm
- Phase error at peak power : < 5 ° RMS
- Frequency error : +/- 0.1 ppm max

Audio Interface – Electrical Characteristics

Speaker Output

Differential speaker output capable of driving 8 ohm load. 1.0945 Vpp (differential) typical.

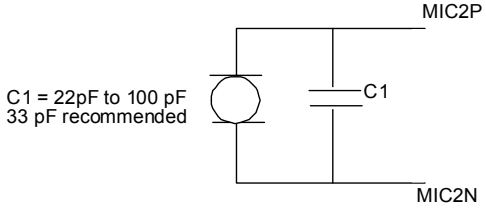
Microphone Input

Balanced microphone input: full scale input 1.1 Vpp.

Microphone Inputs

The MIC inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone has to be around 2K. These inputs are the standard ones for a handset design.

The gain of the MIC inputs is internally adjusted. The gain can be tuned from 30dB to 51dB. The connection to the microphone is direct.



Peripheral Devices

Antenna

An antenna with an SMA connector may be directly connected to a SocketModem EDGE through a mating MMCX to SMA adapter.

Antennas Available from Multi-Tech:

Description	Part Number
Hinged Right Angle 900/1800 MHz Cellular Modem Antenna	ANF1-1HRA
Hinged Right Angle 800/1900 MHz Cellular Modem Antenna	ANCF2-1HRA

Antenna Adapter Connector

The integrated modem antenna connector is an MMCX adapter. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size, which is 50% of the standard MCX connector.

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MMCX / SMA Connector Available from Amphenol

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Antenna Cable

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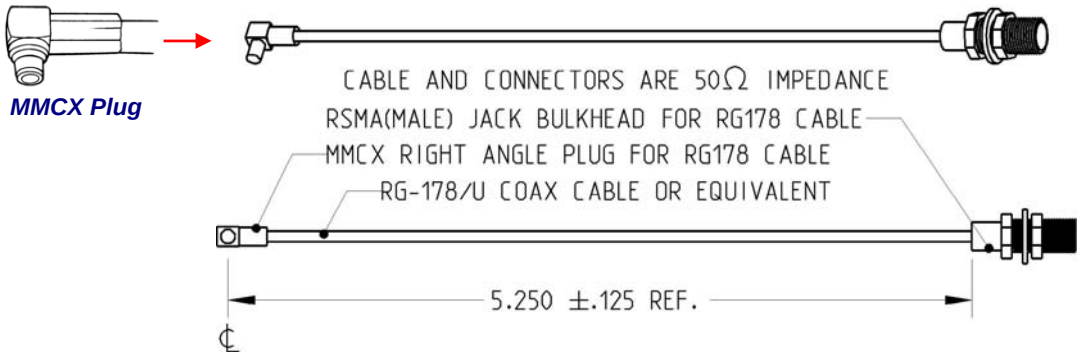
CASMA-MMCX-10	SMA to MMCX COAX RF 6 inch cable (Ten Pack)


MMCX Plug
CABLE AND CONNECTORS ARE 50Ω IMPEDANCE
RSMA(MALE) JACK BULKHEAD FOR RG178 CABLE
MMCX RIGHT ANGLE PLUG FOR RG178 CABLE
RG-178/U COAX CABLE OR EQUIVALENT
5.250 ±.125 REF.
SMA Jack

Antenna Cable – SMA Jack to MMCX Plug

Chapter 11

SocketWireless® Wi-Fi®

MT800SEM

Chapter 11 – SocketWireless Wi-Fi (MT800SWM)

Introduction

The SocketWireless Wi-Fi device server connects serial devices to an IP network via 802.11b wireless networking. It enables you to build wireless networking into virtually any device allowing for remote monitoring, control and configuration. The space efficient module (1" x 2.5") integrates a complete TCP/IP protocol stack. It can make your existing and next generation device, machine or system, IP-ready while you focus on developing its core features.

Ordering Information

Product	Description	Region	Order this Product ✓
MT800SWM	802.11b Device Server, 5V	Regional	
MT800SWM-L	802.11b Device Server, 3.3V	Regional	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Regional	

How to Read the Product Codes in the Table Above:

L	3.3V
UDK	Universal Developer Kit

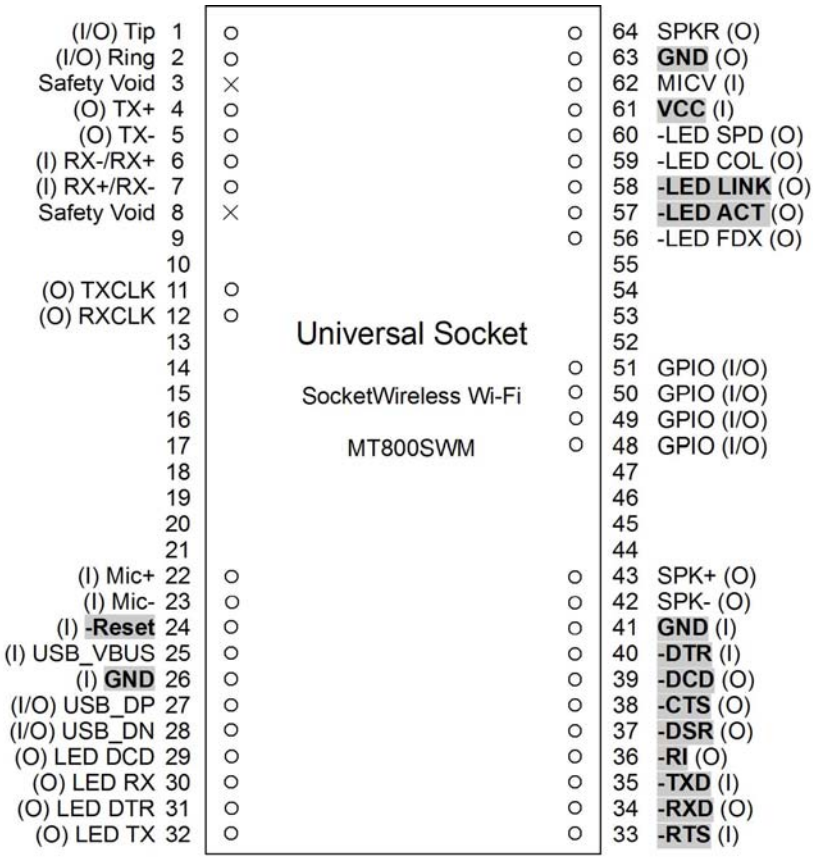
Technical Specifications

The SocketWireless Wi-Fi meets the following specifications:

Category	Description
Standard	Internet Interface: 802.11b
Frequency Range	2.400 to 2.484 GHz
Data Format	Serial, asynchronous, 3.3V
Character Format	8N1
Data Rate	Software selectable: 1200 bps to 230K bps
Antenna Connector	MMCX
Maximum Tranmit Power	16 dBm
Receiver Sensitivity	-82 dBm
Dimensions	2.541" L x 1.045" W x 0.680" (6.45 cm x 2.65 cm x 1.7 cm)
Weight	0.6 oz. (0.017 kg.)
Power Consumption	**Typical:** 240mA @ 5VDC **Idle:** 80mA @ 5VDC
Operating Temperature	-30° to +70° C
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	3.3VDC or 5VDC
Certifications & Approvals	**Safety Certifications:** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals:** FCC Part 15 Subpart C Canada RSS-210 EN 300 328 EN 301 489-17
Intelligent Features	Complete serial-to-Wi-Fi wireless connectivity solution including network processor, media access controller, and air interface Wi-Fi Security using 64/128 bit WEP Supports Ad Hoc and Infrastructure Mode Network Protocols Supported: ARP, DHCP client, FTP client, ICMP (PING), IP, POP3, SMTP client, TCP, UDP Configuration and Management via AT Commands Flash memory to update firmware with the latest enhancements
Warranty	Two years

SocketWireless Wi-Fi Configuration

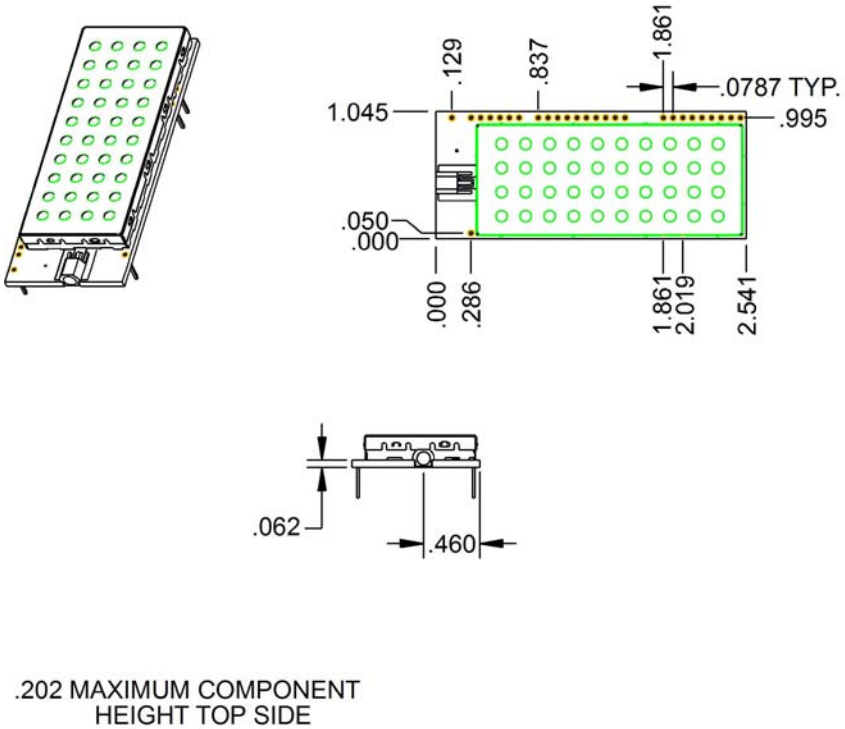
The SocketModem Wi-Fi uses a 16-pin interface that provides an 802.11b wireless network conncection to provide a complete serial-to-Wi-Fi connectivity solution.



SocketWireless Wi-Fi Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Mechanical Dimensions



Electrical Characteristics

3.3V Serial

3.3VDC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3V ± 0.3V) VDDMAX = 3.6V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	**Input High** Min 2.52V	**Input Low** Max 0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

5V Serial

5VDC Characteristics (TA = 0 °C to 50 °C; VDD = 5V ± 0.25V) VDDMAX = 5.25V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	**Input High** Min 2.52V	**Input Low** Max .0.8V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3V	**Output Low** Max 0.4V	**Current Drive** 2mA
Digital Input Capacitance			**5 pF**

Note: All digital inputs/outputs are 3.3V only.

Application Notes

RF Interface

Radio Characteristics

Frequency……2402 – 2480MHz
Modulation……...DSSS
Number of Channels….1 to 14
Transmission Rate…….1, 2, 5.5, 11Mbps

RF Receive Sensitivity	-82dBm typical
RF Transmit Power	16 dBm

Default Power Up Settings

Baud Rate = 115200 bps
Data Bits = 8 bits
Parity = None
Stop bits = 1 bit
Hardware Flow Control RTS/CTS = Disabled

Sources for Peripheral Devices

Antenna Requirements

Frequency Range	2.4-2.5 GHz
Impedance	50 ohm nominal
VSWR	<2.0:1
Gain	2 dBi
Radiation	Omni
Polarization	Vertical
Wave	Dipole ½ Wave
Connector	Reverse Polarity SMA Plug

Antenna Available from Multi-Tech:

Part Number	Description
ANBT-1HRA	Hinged Right Angle 2.5 GHz ½ Wave Reverse Polarity Antenna

Antennas also can be ordered from the following manufacturers. For the manufacturers listed without specific part numbers, be sure to select the antenna that meets the requirements listed above.

http://nearson.com (part number S131AH-2450S)

http://www.ead-ltd.com

http://www.centurion.com

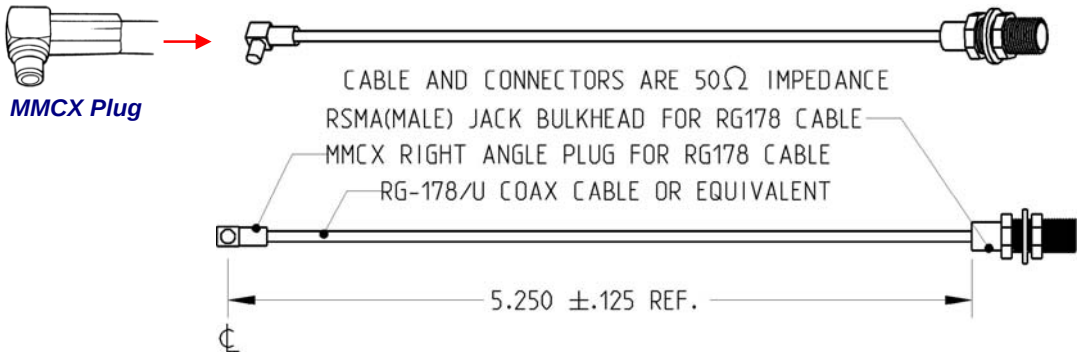
http://www.mobilemark.com

http://woken.com

Antenna Cable

An optional 6" antenna cable (SMA Jack to MMCX Plug) can be ordered from **Multi-Tech Systems, Inc.**

Part Number	Description
CARSMA-MMCX-1	Reverse SMA to MMCS COAX 6 inch cable (Single Pack)


MMCX Plug
CABLE AND CONNECTORS ARE 50Ω IMPEDANCE
RSMA(MALE) JACK BULKHEAD FOR RG178 CABLE
MMCX RIGHT ANGLE PLUG FOR RG178 CABLE
RG-178/U COAX CABLE OR EQUIVALENT
5.250 ±.125 REF.
SMA Jack

Antenna Cable – SMA Jack to MMCX Plug

Approved Antenna Cable Parts

GC Protronics	20930C
Samtec	ASP-116785-01
Coax Cable	RG-178/U

Chapter 12

SocketWireless® Bluetooth®

MTS2BTSMI

Chapter 12 – SocketWireless Bluetooth (MTS2BTSMI)

Introduction

The Multi-Tech Systems, Inc. SocketWireless with Bluetooth-enabled technology allows developers to establish wireless networks using a special set of AT commands. The SocketWireless with Bluetooth technology makes the cable-replacement transition to wireless networks seamless and easy.

This chapter explains how to establish Bluetooth communication between two serial devices for data applications in a point-to-point network. Bluetooth-enabled devices create communication-ready devices by integrating data functionality into a single, universal socket design. This complete, ready-to-integrate device dramatically reduces development time and costs for system designers.

Origin of the Term "Bluetooth"

An initial effort to standardize wireless transmission between a variety of devices such as PCs, cordless telephones, headsets, printers, and PDAs was in the form of a consortium (April, 1998) of Intel, Microsoft, IBM, Toshiba, Nokia, Ericcson, and Puma technology. The project was code-named Bluetooth after Harald Blaatand (Bluetooth), the 10th century Danish king who unified Denmark and Norway. ***— from Newton's Telecom Dictionary, 20th Edition***

Notes about Byte Gaps and Data Latency

Because of the way Bluetooth is designed and operates, random byte gaps of 5 ms to 20 ms are common. Packet size will vary from transmission to transmission.

Although the serial bandwidth operates up to 920K bps, effective data throughput in fast streaming mode is approximately 200K bps. Effective data throughput in regular data mode is 60K bps. The reason for the slower speed in regular mode is due to the AT parser, which looks at each character for ASCII valid command scripts in the regular mode's data stream.

The SocketWireless RX has very limited buffering, so if you do not use hardware flow control and are transmitting further distances, you will quickly overflow the 50 byte buffer because of RF retransmissions, etc.

When a Bluetooth connection is made, the SocketWireless device goes into regular data mode per the power-up factory default settings. This enables the user to remotely configure the SocketWireless settings via a remote RF Bluetooth connection. Basically, you can setup the SocketWireless device so no commands are required to be sent from the embedded side of the device. This allows seamless interfacing with legacy systems without the need to modify the host device

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTS2BTSMI.R2	Serial-to-Bluetooth Module, C1 V1.2, 5V	Global	
MTS2BTSMI-L.R2	Serial-to-Bluetooth Module, C1 V1.2, 3.3V	Global	
Developer Kit			
MTSMI-UDK	Universal Developer Kit	Global	

How to Read the Product Codes in the Table Above:

C1 V1.2	Class 1 Bluetooth V1.2 compliant
L	3.3V
UDK	Universal Developer Kit

Other Product Codes:

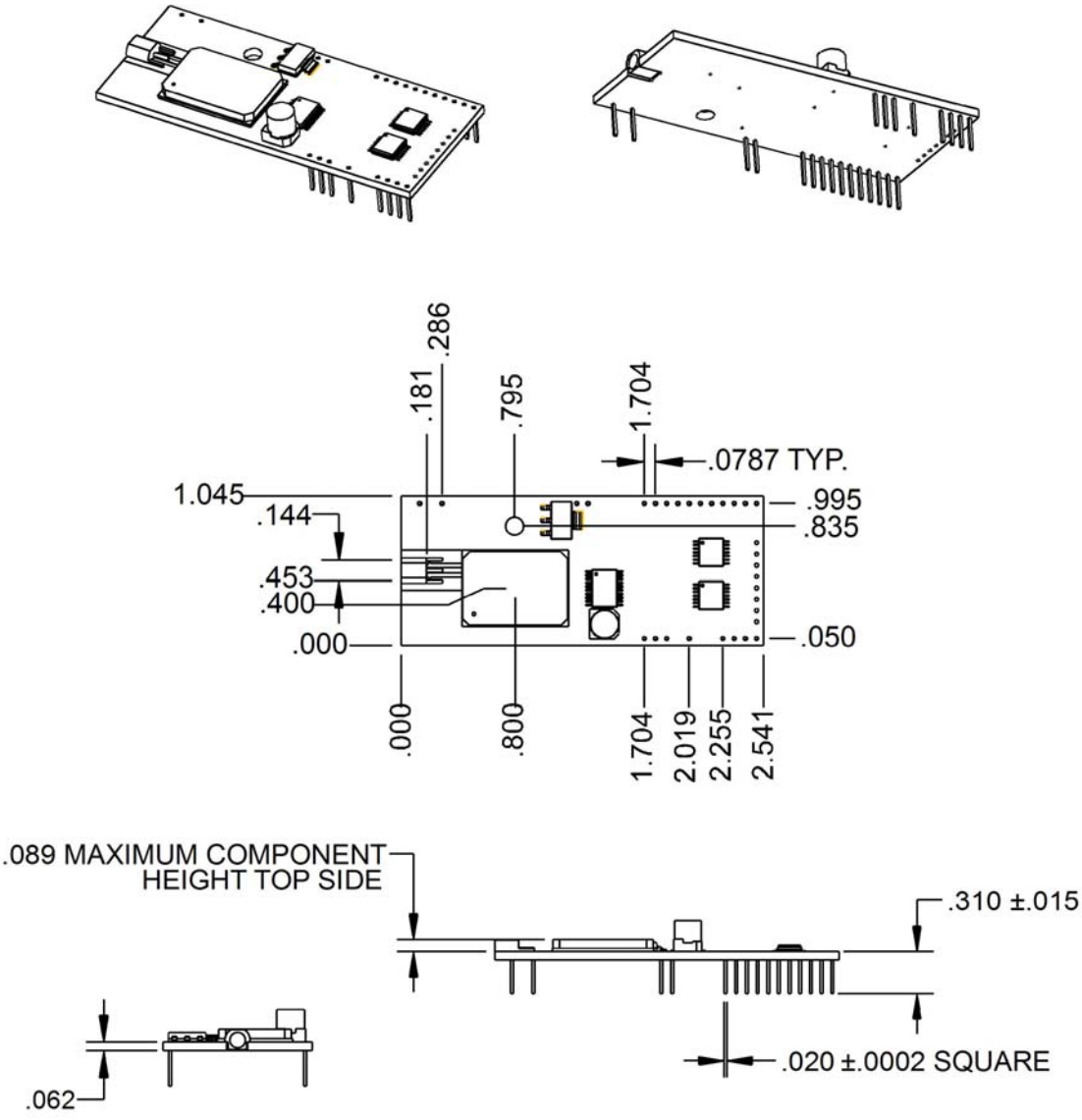
R*x* "R" indicates product revision. "*x*" is the revision number.

Technical Specifications

The SocketWireless Bluetooth (MTS2BTSMI) meets the following specifications:

Category	Description
Standard	Class 1 Bluetooth V1.2 compliant
Bandwidth	2402 to 2480 MHz
Data Format	For Serial Interface - Asynchronous
Serial Speeds	Supports speeds from 1200 bps to 920K bps
Flow Control	Hardware
Output Level (Class 1)	20dBm maximum
Modes of Operation	Inquiry, Idle, Data, Fast Data, Park, Sniff, Command, Master, Slave
Device Profiles	Serial Port (SPP), Dial-up Network (DUN)
Buffer	**Serial** 50 bytes **RF** 50-byte RX buffer
Dimensions	2.541" L x 1.045" W x 0.680" (2.65cm x 6.45cm x 1.7cm)
Weight	0.6 oz. (0.017 kg.)
Power Consumption	**Idle:** 2mA (0.0066W @ 3.3VDC) (0.01W @ 5VDC) **Connected:** 7mA (0.0231W @ 3.3VDC) (0.035W @ 5VDC) **Fast Data:** 45mA (0.1485W @ 3.3VDC) (0.225W @ 5VDC) **Inquiry:** 70mA (0.231W @ 3.3VDC) (0.35W @ 5VDC) **Notes:** These power measurements were taken with no LEDs connected. Driving an LED through 330 ohm resistor to GND draws an additional 4mA on 5V for each LED.
Operating Temperature	-40° to +70° C
Storage Temperature	-40° to +85° C
Humidity	20% to 90% (non-condensing)
Operating Voltage	5VDC or 3.3VDC Minimum and Maximum Voltage: 3.3VDC ± 0.1V & < 10mVp-p noise 5VDC ± 0.1V & < 10mVp-p noise
Certifications & Approvals	**Safety Certifications:** UL 60950 cUL 60950 EN 60950 AS/NZS 6950:2000 **EMC Approvals:** FCC Part 15.247:2004 (subpart C) EN 301 489-1 V1.4.1 (2002-08)
Intelligent Features	Can be configured, commanded, and controlled through simple ASCII strings over the Bluetooth RF link or directly through the hardware serial UART. Low power consumption. Secure and robust communication link. • FHSS (Frequent Hopping Spread Spectrum) • 56-bit encryption, and 10 alphanumeric Personal Identification Number (PIN) • Error correction schemes for guaranteed packet delivery Operating System independent AT command software interface LED driver outputs for visual monitoring speed, link, activity, collision, and duplex mode. Auto connect.
Warranty	Two years

Mechanical Dimensions



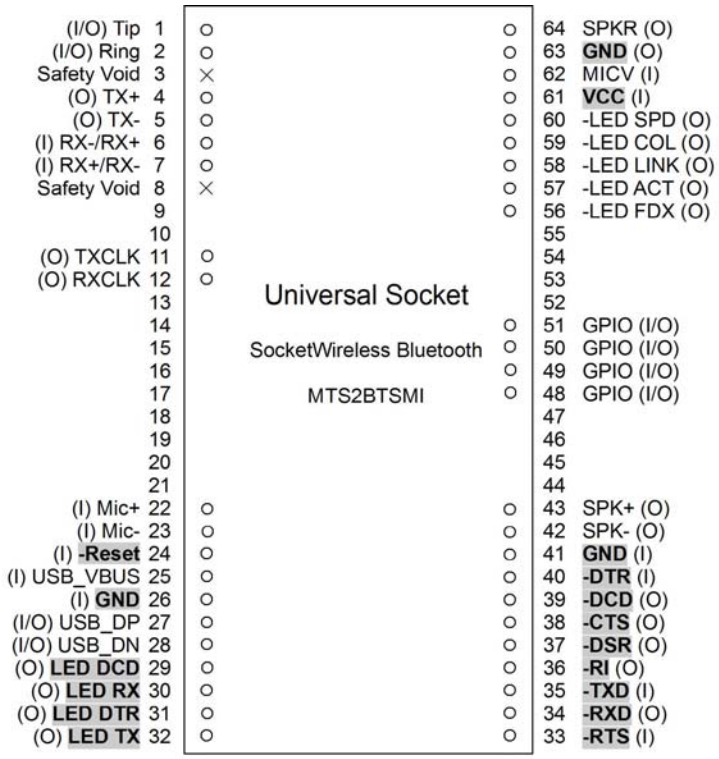
SocketWireless Bluetooth Mechanical Drawing

SocketWireless Bluetooth Configuration

Serial Configuration

The MT2BTSMI SocketWireless uses a 17-pin interface.

Note: The bolded, shaded pins are the active SocketWireless pins.



Top View – SocketWireless Bluetooth Pinout

For pin descriptions, see the *Universal Pinout Descriptions* in Chapter 1.

Electrical Characteristics

5V Serial SocketWireless

5VDC Characteristics (TA = -40° C to +70° C; VDD = 5V ± 0.25V) VDDMAX = 5.25V

Inputs	**Input High**	**Input Low**	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0V	Max 0.8V	
–RESET (24)	Min 2.0V	Max 0.8V	
Input Capacitance			**15 pF**
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34)	Min 4V / 2.4V	Max 0.5V / 0.5V (5V / 3.3V)	3.2mA, 7.0mA for TXD

3.3V Serial SocketWireless

3.3VDC Characteristics (TA = -40° C to 70° C; VDD = 3.3V ± 0.3V) VDDMAX = 3.6V

Inputs	**Input High**	**Input Low**	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0V	Max 0.8V	
–RESET (24)	Min 2.0V	Max 0.8V	
Input Capacitance			**15 pF**
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34)	Min 2.4V	Max 0.5V / 0.5V (5V / 3.3V)	3.2mA, 7.0mA for TXD

Application Notes

RF Interface

Radio Characteristics

Frequency……2402 – 2480MHz
Modulation……..FHSS/GFSK
Channel Intervals……1MHz
Number of Channels….79CH
Transmission Rate…….721Kbps

RF Receive Sensitivity	-80dBm typical
RF Range	**Class 1** - 100 meters (330 feet)

Default Power Up Settings

AT Command Response Form = Long Form
Bluetooth Service Profile = Serial Port Profile {SPP}
Device Role = Slave
Baud Rate = 9600bps
Data Bits = 8 bits
Parity = None
Stop bits = 1 bit
Hardware Flow Control RTS/CTS = Enabled
Power Mode = Never go into deep sleep mode
Country Code = North America and Europe
Name of Device (local name) = SocketWireless
My Radio Status = 1,0 {slave, disconnected}
Service Name = COM0
Power up default ATSW24 settings = 0,0,0,0 {long response, no authentication, no auto SCO connect, no minor}
Power up default ATSW25 settings = 0,1,0,0 {slave, data, allow data to pass, SPP}
Major & Minor Class Of Device (COD) = 00000000 {undefined}
Security PIN and Encryption Disabled
Default PIN = “default” *caps sensitive*

Important Security PIN Note:
Do not forget your PIN. Write it down. If you forget it, there is no way it can be retrieved from the device or the software. You will have to buy a new Bluetooth module and start over.

Page Scan Interval = 0x400 {2560msec.}
Page Scan Window = 0x200 {11msec.}
Inquiry Scan Interval = 0x400 {2560msec.}
Inquiry Scan Window = 0x200 {11msec.}
Timeout Connection Parameters
Inquiry = 60 seconds
Slave Connect = 60 seconds
Master Connect = 60 seconds
ATDM idle mode = 60 seconds
ATDM Master Mode = indefinitely (need to perform **ATUCL** to cancel last command)
Timeout for loss of Bluetooth connection = 4 seconds

Example of a Master Discovery/Connection Sequence

From Power Up and No Connection

1. Verify local device is Master in Data Mode.
   Sent: ATSi,7 **<cr_lf>**
   Reply: <cr_lf>1,1,0,0**<cr_lf>**
2. If not Master, set to Master and Data Mode.
   Sent: ATSW25,1,1,0,0 **<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**
3. Perform an Inquiry to obtain BT_Addresses (unless it is already known).
   Sent: ATMC **<cr_lf>** // Places Radio in Command Mode
   Reply: <cr_lf>OK**<cr_lf>**
   Sent: ATUCL // Clears radio state
   Reply: <cr_lf>OK**<cr_lf>**
   Sent: ATDI,1,00000000 {Class of Device}**<cr_lf>** // Looks for only one Bluetooth device
   Reply: <cr_lf>00A0961F2023,00000104,SOCKETWIRELESS**<cr_lf>**DONE**<cr_lf>**CONNECT **<cr_lf>**
4. Perform a Master Connect over SPP using the BT_Address.
   Sent : ATDM, 00A0961F2023,1101**<cr_lf>** // SPP connection
   Reply:<cr_lf>CONNECT**,**00A0961F008F **<cr_lf>** // Returns Slave BT address radios is in data mode
5. Place radio into Fast Data Mode.
   Sent : ATMC **<cr_lf>** // Places Radio in Command Mode
   Reply: <cr_lf>OK**<cr_lf>**
   Sent : ATMF**<cr_lf>** // Places radio in Fast Data Mode
   Reply: <cr_lf>OK**<cr_lf>**
6. Send Data.

Note about Sending Commands from the Slave When the Slave Connects in Fast Data Mode (ATSW25/or issuing ATMF)
All valid AT commands sent through the Slave's UART will be interpreted and responded by the Master as if it were the local Slave radio. Basically, in this configuration from the Slave end, you can obtain status and configure the remote Master radio. This is a unique feature that may be useful in some applications, but it can be confusing if you think you are talking to the Slave.

To Get Out of Data Mode and Check Status

1. Delay at least 50 milliseconds; this could be less or more.
2. Perform a Set Command Mode.
   Sent : ATMC**<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**
3. Delay at least 50 milliseconds.
4. Check Status, perform a Disconnect …
   Sent : AT**<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**

Note about Being Connected in Fast Data Mode
If connected in Fast Data Mode, it is necessary to reset the device to break the connection.

Example of a Slave Command Sequence

From Power Up:

1. Check and verify Communication to Slave.
   Sent : AT**<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**
2. Get information on Slave Bluetooth address.
   Sent : ATSi,1**<cr_lf>**
   Reply: 12-digit address
   <cr_lf>OK**<cr_lf>**
3. Set Slave to automatically connect in Fast Data Mode on Bluetooth connection.
   Sent : ATSW25,0,0,0,0 **<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**
4. Either cycle power or send ATURST.

Note: This command sequence assumes the radio is in factory default in which it automatically comes up and is connectable as a Slave from a Master request.

Disabling Flow Control Using AT Commands

Using a terminal screen with flow control enabled, issue commands to turn off flow control.

Sent : ATSW22,3,1,0 **<cr_lf>** // Set PIO3 as output and do not store in flash
Reply: OK**<cr_lf>**
Sent : ATSW23,3,1,0**<cr_lf>** // Set PIO3 output high and do not store in flash
Reply: OK**<cr_lf>**

To store the setting in flash:

Sent : ATSW22,3,1,1 **<cr_lf>** // Set PIO3 as output and store in flash
Reply: OK**<cr_lf>**
Sent : ATSW23,3,1,1**<cr_lf>** // Set PIO3 output high and store in flash
Reply: OK**<cr_lf>**

Now you can communicate with the Bluetooth device with flow control turned off.

Changing Configuration

Parameters, such as the Bluetooth Name, Service Name, Class of Device, and Serial Port settings can be viewed and configured. This can be done locally through the serial port UART or from a remote Bluetooth RF link. To configure the SocketWireless Bluetooth device, the device must be in command mode by issuing **ATMC**.

You can use the developer board and the RS-232 cable to connect to a PC and pass ASCII characters through the terminal to the SocketWireless Bluetooth device. The communications settings should match the settings used when the SocketWireless Bluetooth device connects. For example, the defaults are:

9600bps
8 bits
No Parity
1 stop bit
Hardware flow control enabled.

Once you change these parameters, you have the option to store them permanently in the non-volatile memory. Run your favorite terminal emulator, HyperTerminal, or other program.

- Type **AT** on your screen and follow it with a carriage return **<cr_lf>**. You should see "**OK**" returned to you. This will verify that your cable and communications settings are correct. When the SocketWireless device is not connected to another Bluetooth device, you can type the AT commands directly into the SocketWireless' UART; e.g., you do not have to type **ATMC** to change from data mode to command mode.
- Now you can enter any of the AT commands discussed in the following sections. Follow these commands by **<cr_lf>**. Valid commands will return an "**OK**" or a valid response. Invalid commands will reply **ERROR**.
- To return to data mode, type **ATMD**. You can now pass or receive data from a remote connected Bluetooth device.

Notes:

- If you change communications parameter settings, remember to change your terminal or emulator communications settings to correspond to the newly created parameter settings.
- AT commands will not echo back to the terminal.

Sources for Peripheral Devices

Antenna Requirements

Frequency Range	2.4-2.5 GHz
Impedance	50 ohm nominal
VSWR	<2.0:1
Gain	2 dBi
Radiation	Omni
Polarization	Vertical
Wave	Dipole ½ Wave
Connector	Reverse Polarity SMA Plug

Bluetooth Antenna Available from Multi-Tech:

Part Number	Description
ANBT-1HRA	Hinged Right Angle 2.5 GHz ½ Wave Reverse Polarity Antenna

Bluetooth antennas also can be ordered from the following manufacturers. For the manufacturers listed without specific part numbers, be sure to select the antenna that meets the requirements listed above.

http://nearson.com (part number S131AH-2450S)

http://www.ead-ltd.com

http://www.centurion.com

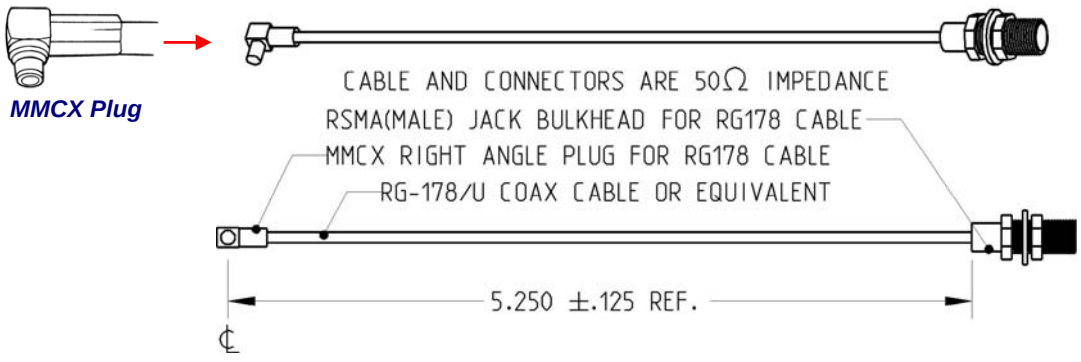
http://www.mobilemark.com

http://woken.com

Antenna Cable

An optional 6" antenna cable (SMA Jack to MMCX Plug) can be ordered from **Multi-Tech Systems, Inc.**

Part Number	Description
CARSMA-MMCX-1	Reverse SMA to MMCS COAX 6 inch cable (Single Pack)


MMCX Plug
CABLE AND CONNECTORS ARE 50Ω IMPEDANCE
RSMA(MALE) JACK BULKHEAD FOR RG178 CABLE
MMCX RIGHT ANGLE PLUG FOR RG178 CABLE
RG-178/U COAX CABLE OR EQUIVALENT
5.250 ±.125 REF.
SMA Jack

Antenna Cable – SMA Jack to MMCX Plug

Approved Antenna Cable Parts

GC Protronics	20930C
Samtec	ASP-116785-01
Coax Cable	RG-178/U

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